THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 190.

1880.

THE year 1880 has been more particularly marked by the progress which has been made in the electric light and the telephone. Comparatively little has been done in the way of startling novelties in these branches of electrical science, though their practical adaptations have been strikingly rapid. The use of the electric light has been extended in a progressive manner, and the confidence of the public in it has become nearly complete, and it has almost ceased to be looked upon as a novelty. In spite of this advance, the welfare of the gas companies does not appear to have suffered; and a year of undeniable and steady progress of the electric light in this country has done less to affect the value of gas stock than did the unconfirmed rumours of success which were cabled from America. Whether the formation of large and influential electric light companies in this country will again cause a scare to be produced remains yet to be seen; but the fact that the shares in these companies are being largely subscribed for shows that the public are quite alive to the growing importance of the electric light. The coming trial of the light in the City of London will go far to insure its more extensive adoption.

The spread of the telephone system in all the large towns of the United Kingdom has been effected with astonishing rapidity, and though possibly the recent decision of the Exchequer Court in favour of the Government will check to a certain extent further operations at the hands of the companies, the invention has proved such a necessity for business that its extension at the hands of the State will no doubt be very great. The instrument which up to the present has given the best results is the Gower-Bell telephone, whose success dates from the past year.

The telephone patents taken out in 1880 are fairly numerous, though at the present time the ardour of inventors has somewhat abated. Amongst the transmitters may be mentioned that of Theiler, which has been adopted by the Swiss Government.

The electric light patents have been very numerous; but, again, in this branch of invention, enthusiasm has somewhat abated of late.

As regards the electrical patents taken out during the year ending December 4, the total number is no less than 270, a fact which indicates fairly the amount of interest taken in electrical matters, and may be taken as indicative of the part which electricity is likely to play in the future in every branch of the arts.

Amongst the electric light systems, the Jablochkoff, Brush, and Siemens continue to hold the first place, whilst the systems of Lontin, Jamin, Werdermann, and especially Crompton, are vigorously pushing their way. The lamp of Mr. Brockie is a distinct departure from the ordinary method of regulation, and promises good results. More recently the experiments of Mr. Swan, of Newcastle, who has been working quietly at the incandescent system, have excited considerable interest. The Swan system seems admirably adapted for domestic purposes.

Apropos of the gas question, the use of gas-engines for driving the dynamo machines and for other purposes is becoming very considerable. A new field for the use of gas is thus opened.

In dynamo machines but little has been done, though several new forms have been suggested, but not yet brought into practical use.

Next to the telephone and the electric light, the application of electricity to the production of motive power has excited the greatest interest, and especially the branch of the question which has reference to railways. Dr. W. Siemens has brought the subject very prominently forward, and at the present time several short lengths of electrical railways are in contemplation or construction. The question seems likely to be of considerable importance.

Dr. C. W. Siemens' experiments on the effect of the electric light upon vegetation have shown that the forcing of plants and vegetables could be considerably stimulated by artificial illumination, and according to calculation it seems even probable that the process would be a profitable one.

The introduction of electrical fire-alarms has at last been taken up in earnest by the City of London authorities; at the present time two systems have and are being submitted to a thorough trial. The one is the Exchange, and the other Bright's system.

During the year several sittings have been held by the Lightning-rod Committee appointed by the Society of Telegraph Engineers, and a report upon their deliberations is promised before long.

A committee has been appointed by the British Association to revalue the ohm.

In experimental work, undoubtedly the most remarkable discovery of the year has been the Photophone of Professor Bell, in which the action of light has been to produce sound. It is difficult to say at present whether any practical results will arise from the remarkable discovery.

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Professor Minchin's experiments upon the action of light in producing currents of electricity have been very original and interesting.

In telegraphy no very marked improvements have been manifest, though a good deal of quiet work has been done. The papers read before the Society of Telegraph Engineers have been of considerable interest, and show that the society is doing useful work. The opening of the Ronald's library has put into the hands of the public a most valuable source of scientific information which it is hoped will be duly appreciated.

The laying of a seventh Atlantic cable, making four in working order, has been effected during the year, and several short lengths have been laid, but the successful carrying out of such works is now such a matter of course that but little scientific interest is aroused.

The City and Guilds Institute is now fairly started and is doing excellent work in all branches of physical science as applied to the arts, electricity and telegraphy not being neglected.

A FIRE ALARUM APPARATUS.

By T. M. BANKER.

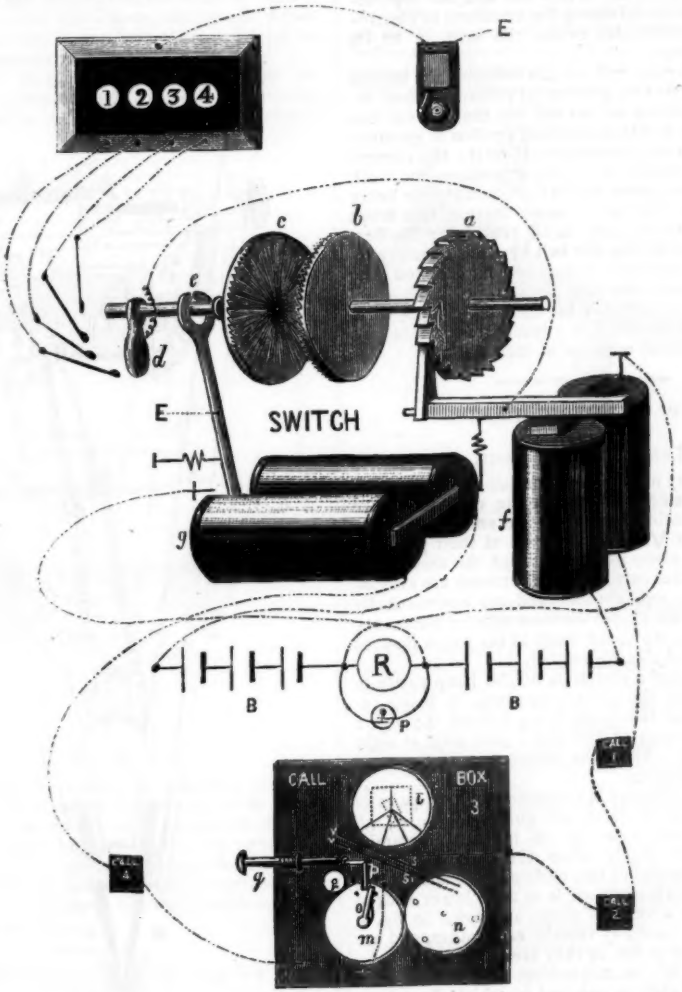
THIS fire alarum is arranged on the metallic circular system giving the call on an ordinary indicator, using only one wire with a permanent current. The permanent current is greatly reduced in strength by means of a resistance coil which is inserted in the line when the circuit is in its normal condition, so as to retard the usually quick exhaustion which occurs when the batteries are constantly working through a small resistance such as constitute a fire alarum circuit.

The apparatus at the fire station consists of a switch, indicator with bell, resistance coil, push button, and batteries. By referring to the sketch the following explanation will point out its action :—Switch : ratchet wheel, *a*, is on the same spindle as the wheel, *b*, the latter having its face towards *c*, cut with ratchet teeth, *c* also having its face towards *b* cut with ratchet teeth of the same pitch as *b*, so that when the two wheels are together they fit each other and form a clutch. The wheel, *c*, is fixed on a spindle whose axis is in the same line with that of *a*, *b*, and is free to move in its bearings for a short distance longitudinally, so as to free itself from *b* when required. On the same spindle as *c* are two collars, *e*, between which the forked end of the armature lever of the electro-magnet, *g*, plays and imparts the longitudinal motion to the spindle in one direction or the other, as the armature of *g* is attracted or released, hence makes or breaks the clutch between *b* and *c*. At the extremity of the same spindle is an arm, *d*, weighted so that when the clutch is separated it at once drops down into a vertical position forming its normal condition ; this arm as it is carried up forms circuits in succession through the indicator by means of springs, each spring being connected to a different hole of the indicator ; the rachet wheel, *a*, receives its motion in the direction of the arrow from the detent attached to the end of the lever belonging to the armature of the electro-magnet, *f*, and is prevented from a retrograde motion by a second detent not shown in sketch. The battery, B, is divided into two parts having the resistance coil, R, inserted between the parts, and when necessary the resistance can be cut out of circuit by pressing in the button of push P.

The call box, which can be placed in a niche in almost any wall or street post, may be made to occupy a very small place, as the mechanism need not be large or cumbersome. When the knob, *q*, is pulled out it sets the train work in motion, and the act of pulling out the knob also winds up either a spring or weight sufficiently to actuate the mechanism for giving the signals, and as soon as the signals have been delivered the knob, which was locked on being pulled out, returns to its former position, stopping the train work, therefore it is always ready for use, being entirely automatic in its action. The knob, *q*, is locked out by means of one end of a bell crank lever, *p*, dropping against its end, and held tight in this position by the spiral spring surrounding the spindle of *q*. The drum, *m*, which is wound up by the action of pulling out the knob, *q*, has on its arbor a lever, *o*, that revolves with *m*, having its play limited by two stop pins, against the left of which it is gently held by a slight spring until it meets with the lower arm of the bell crank lever, *p*, where the pressure becomes sufficient to overcome the strength of the spring and carries it to the right-hand stop pin, here it commences to press up the bell crank lever, *p*, until it liberates the knob, *q* ; on accomplishing this the lever, *o*, is pressed again against the left-hand stop pin by its spring, so that if the knob should be pulled out again immediately after returning to its usual position the mechanism can at once commence to repeat its signals. Wheel *n* is in gear with *m*, and, connected to the earth, has on one side of it as many contacts as are required to lift the arm, *d*, of switch to the spring in connection with its hold of the indicator, whilst on the other side it has a contact following the others which drops the indicator and rings the bell. Wheel *r* has the fly on its arbor and also the friction roller of the break for stopping the train work. The galvanometer, *t*, is constructed on the single needle principle, with a circular disc in place of the usual indicating needle, having a quadrant of it divided into three differently coloured segments, so as to correspond to the three different electrical states of the wire—that is, when no current is passing or the knob has been pulled out, the magnet of the coil would hang vertically and show the word "engaged" on the disc. When the resistance coil, R, is in circuit the amount of current passing would expose that part of the disc having the words "ready for use" on it. After a call has been received, by pressing in the button of push P, throwing all the current on the line, that portion of the disc having "call received" would appear. Pulling out the knob, *q*, also disconnects the galvanometer belonging to that box from the line by releasing the two springs, *s*, s^1, from the contacts attached to the ends of the coil wires, but is again put in circuit on the knob returning to the normal state.

The electrical connection from the right-hand side or zinc end of the battery, B, passes through the electro-magnet, *f*, then through all the galvanometers of the call boxes, 1, 2, 3, 4, on the circuit to the electro-magnet, *g*, returning to the copper end

or left-hand side of the battery. Attached to the right-hand side of the resistance coil, R, placed in centre of battery, is a wire going to the upper limiting stop of lever of electro-magnet, *g*, while the lever itself is connected to the earth, but insulated from other parts of the apparatus. On the left-hand side of the resistance coil, R, is another wire going to the upper limiting stop of the lever of the



electro-magnet, *f*, while the lever itself, which is insulated from other parts of the apparatus, has a wire going to the insulated arm, *d*.

When the circuit is in working order, but not working, both armatures of the electro-magnets, *f*, *g*, are held down (thereby separating the clutch, *b*, *c*) by the reduced current on line; this reduced current is sufficient to hold the armatures to the coils, but not sufficiently powerful to do the work required in bringing the armatures to the coils. The wires attached to the upper limiting stops of the electro-magnets are insulated when both armatures are on their coils.

When the circuit is broken—say at the call box 3, by pulling out its knob—both electro-magnets lose their magnetism, and the armatures are pulled away from the coils by their respective spiral springs to their upper stops, putting the right-hand wire to earth, and the left-hand wire to earth through the indicator, after the first signal has been received from the right-hand wire. The clutch, *b*, *c*, also joins, so that on the train work in box 3 running it would put the right-hand wire to earth by means of the spring, *s*, making earth on the contacts on the wheel, *n*, causing the right-hand portion of the battery, B, to magnetise the electro-magnet, *f*, pull-

ing down the armature and moving the ratchet wheel, *a*, forward as many teeth as there are currents sent, and in so doing the arm, *d*, is carried up by means of the clutch, *b*, *c*. When the number of contacts belonging to this special call box has been made, the left-hand side of the wire is put to earth by means of the spring, s^1, and wheel, *n*, causing the left-hand portion of the battery, B, to drop the indicator screen belonging to that call box, and separating the clutch by attracting the armature of electro-magnet, *g*, which also brings the arm, *d*, to its normal condition.

On receiving the call on the indicator the button of push is pressed in, putting all current to line, informing the person at the call box that the call has been received by exhibiting that portion of galvanometer disc having "call received" on it; this current also sets the switch in its right position for work again. I have shown the bell of indicator as being rung momentarily by the same current that drops the indicator screen, but in all probability the best plan would be to ring the bell by a local battery by making the indicator screen when dropped the means of forming the local circuit.

The same system can be used on a single wire, making use of the earth as a return, but in this case batteries would be required at each call box.

NEW ELECTRIC LAMPS.

LESCUYER'S ARC LAMP.

THE peculiarity in this lamp consists in the arrangement of the electrodes, which are each formed of two carbons inclined towards one another so as to form the letter V, and so shaped at their points as to meet in a plane passing through the axis of the apparatus. The two double electrodes are also inclined towards one another, and are automatically maintained at the proper distance apart at the points, by mechanism, while the fixity of the arc is insured by a fan-shaped electro-magnet.

Fig. 1 is a front elevation of the lamp partly in section, one of the electro-magnets, N, being removed to show the parts lying behind it; fig. 2 shows an elevation of the lower part only, at right angles to fig. 1. The same letters refer to the same parts in both figures.

The lamp or burner is composed of two pairs of tubular carbon holders or guides, A, A, A^1, A^1, arranged in the form of an inverted pyramid, through which freely slide the two electrodes respectively formed of two carbons, B, B, and B^1, B^1, bevelled off to an acute angle at their lower ends so as to meet in a vertical plane, as shown in fig. 2, whereby they mutually sustain each other, and are free to descend as fast as they are consumed.

The whole of the mechanism is mounted on a plate, C, to a flange at one end of which the pair of tubular holders, A, A, is permanently attached, a plate of vulcanite, E, being interposed to insulate the holders from the plate. The other pair of holders, A^1, A^1, are hinged at D to the opposite end of plate, C. By means of a set screw, F, the interval between the points of the electrodes may be regulated according to the tension of the current and the length of the arc it is desired to obtain, the said interval being maintained by a spring, G, the tension of which may be regulated as required by a screw, H. I is an electro-magnet placed in a derivation of the current passing through conducting wires, J, J, and K is its armature attached to the carbon holders, A^1, A^1; L, binding stud, to which one of the conducting wires from the generating machine is attached, the other wire being connected to a second stud behind the first; M, M, are gun metal

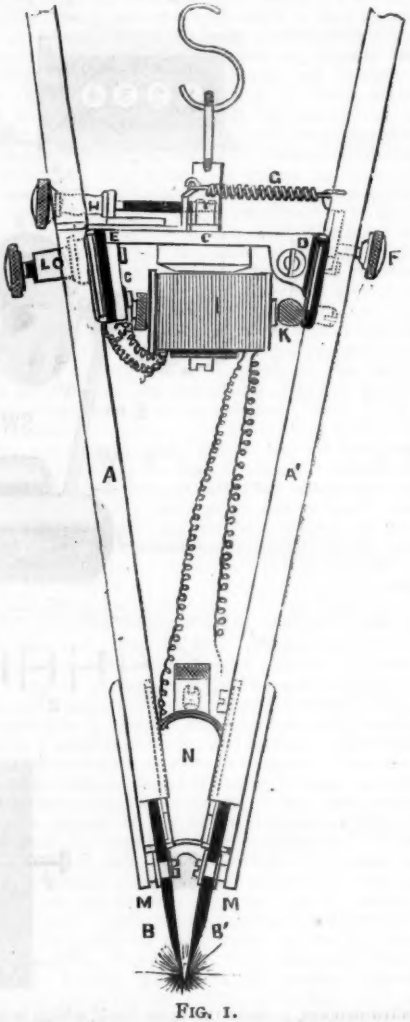


FIG. 1.

rollers, which serve both to guide the carbons and to establish electrical contact between the holders and the carbons near their points, in order that only a short length of the carbon shall be included in the circuit; N, N is a fan-shaped electro-magnet, through which the current passes before entering the carbons, curved prolongations of the cores of the magnet being arranged with regard to the carbons, as shown,

in order to prevent the voltaic arc rising between the electrodes. O, suspension hook.

The action is as follows :—The distance between the point of the double electrode, B, B, and that of the double electrode, B^1, B^1, is first regulated by screw, F, and the binding screws, L, L, are then connected with the two poles of the generating machine. As communication is not yet established between the points of the electrodes the current passes through and excites the electro-magnet, I, which attracts its armature, K, and brings the points of the electrodes in contact with one another.

The current then passes to the points of the carbons, and ceases to flow through the electro-magnet, I, which being demagnetised, releases

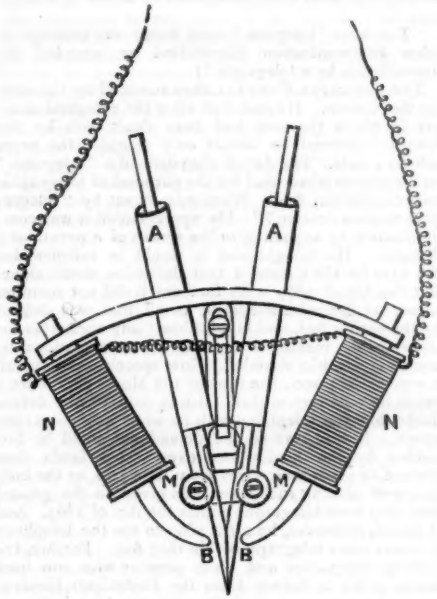


FIG. 2.

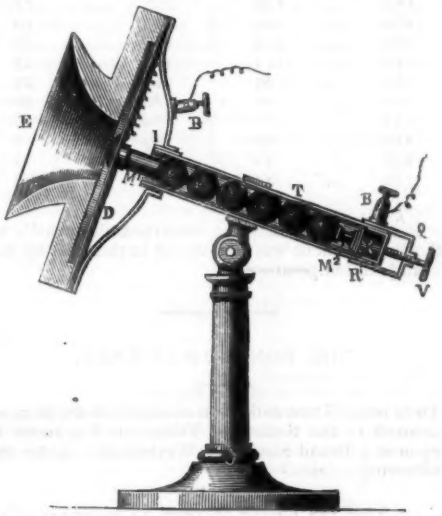
armature, C, and the spring, G, separates the electrodes to the extent previously regulated by screw, F, whereupon the voltaic arc is established ; thus the electro-magnet, I, merely serves to permit the establishment of the arc. The carbons descend by their own gravity, as fast as they are consumed, in a perfectly uniform manner, and their points maintain an invariable position.

NEW MICROPHONE OF M. BOUDET, OF PARIS.

THIS microphone, with multiple contacts, is represented by the figure. It is composed of a mouthpiece, E, fixed at the extremity of a tube of glass, T, of a centimetre in diameter, and fixed on a jointed stand which allows the tube to be set at any convenient angle.

The mouthpiece carries an ebonite plate I millimetre thick, upon which is fixed a mass of copper, M^1, which penetrates a short distance into the glass tube. In this tube six horn carbon balls are placed whose diameters are slightly less than that of the tube, so that they can move freely.

The microphone is completed by a second mass of copper, M^2, set in a cup, K, which slides in the tube and can be adjusted by a set screw, V, and a spring (not shown). The screw, V, fixed on the bridge piece, A, serves to regulate the pressure of the mass, M^2, against the balls. The variations of resistance of the microphone are produced equally on all the contacts of the balls, because, in speaking before the mouthpiece, the vibrations are transmitted almost instantaneously, as in the well-known experiment with a number of billiard balls.



The apparatus works like an ordinary microphone, with six medium size Gaiffe cells (peroxide of manganese and chloride of zinc) joined up in series through a resistance of 800 ohms,* and with a Bell telephone as a receiver.

In employing *induced* currents and a telephone receiver wound with fine wire—a condition necessary with induced currents—the distance can be considerably extended, with artificial resistances, up to 250,000 ohms.

We have assisted at some experiments made with this microphone, and we have noticed that it transmits the voice very clearly, without changing its quality and without gratings.—*La Nature.*

THE EFFECT OF TEMPERATURE ON THE INSULATING VALUE OF PARAFFIN OIL.

WE have been favoured by Mr. David Brooks with the results of some experiments made by him on the effects of temperature on the insulating value of paraffin oil as used by him in his system of underground wires. The experiments were made as

* Practically a resistance of 1 ohm represents that of a pure copper wire 1 millimetre in diameter and 48m. 5 long, or about 40 metres of ordinary copper wire of a similar diameter ; or still further, 97 metres of iron wire 4 millimetres in diameter (ordinary telegraph wire).

ollows :—Two plates of tin of twenty-five square feet superficial arc were placed one-eighth of an inch apart and insulated from one another by a layer of the paraffin oil. The temperature of the oil and plates was raised to 200° Fahr., and allowed to cool slowly. In the circuit of the plates were 300 Daniell cells and a Thomson galvanometer. The following were the deflections obtained at the various temperatures :—

Temperature—Degrees.	Deflections.	Temperature—Degrees.	Deflections.
200 ...	325	130 ...	35
195 ...	280	125 ...	30
190 ...	260	120 ...	26
185 ...	230	115 ...	22
180 ...	180	110 ...	20
175 ...	155	105 ...	17
170 ...	125	100 ...	15
165 ...	105	90 ...	12
160 ...	90	80 ...	10
155 ...	75	70 ...	8
150 ...	60	60 ...	6
145 ...	50	50 ...	5
140 ...	45	40 ...	4
135 ...	40		

It was noticed that the electro-static capacity of the arrangement was not varied in the least by the change of temperature.

THE RONALD'S LIBRARY.

THIS magnificent collection of electrical works now secured to the Society of Telegraph Engineers is open at 4, Broad Sanctuary, Westminster, under the following rules:—

RULES.

1.—That the library be open to members of all scientific societies, and on application to the librarian to the public generally.

2.—The library is open daily between the hours of 11 a.m. and 8 p.m., except on Thursdays and Saturdays, when it closes at 2 p.m.

3.—The library will be closed from August 15th to September 15th, both inclusive, and on all public holidays.

4.—The library is to be used for reference only, and no books, pamphlets, or patent specifications are allowed to be taken from the library.

5.—All works are to be returned to the librarian or his assistant, and are *not* to be replaced on the shelves by the readers.

By Order of the Council,
A. J. FROST, *Librarian.*

From the 1st January, the collection will be opened practically as a free public library till 8 in the evening for four days in the week.

The library contains all the principal scientific periodicals, and arrangements have been made to have all the published specifications relating to electricity immediately after publication.

Mr. Latimer Clark has placed his magnificent collection of electrical works at the disposal of the members of the society, so that they can be seen at his office on application.

THE TELEPHONE CASE.*

In the High Court of Justice. Exchequer Division.

Before MR. BARON POLLOCK *and* MR. JUSTICE STEPHEN.

THE ATTORNEY-GENERAL *v.* THE EDISON TELEPHONE COMPANY, LIMITED.

(*Continued from Vol. VIII., page* 429.)

[IN our analysis of the Information, paragraph 3, the following definitions from the 32nd and 33rd Vic., cap. 73, sec. 3, were accidentally omitted :—

"The term 'telegraph' shall, in addition to the meaning assigned to it in the Telegraph Act, 1863, mean and include any apparatus for transmitting messages or other communications by means of electric signals."

"The term 'telegram' shall mean any message or other communication transmitted or intended for transmission by a telegraph."]

The SOLICITOR-GENERAL then summed up the case for the Crown. He said that after the complete manner in which the case had been dealt with by the Attorney-General he should only consider the more salient points. The Act of 1863 defined a "telegraph" as "a wire or wires used for the purposes of telegraphic communication, &c." What was meant by "telegraphic communication?" He apprehended it was communication by appealing to the senses of a person at a distance. He thought that it would be sufficient for the case for the Crown if that definition stood alone. But the Act of 1869 went further; it did not mention wires, but defined a telegraph as all that was defined by the earlier Act, and in addition "any apparatus for transmitting messages or other communications by means of electric signals." Now speech was a signal, a very perfect one: the taps of the Morse code were a much less perfect signal. It was said by the defendants that the telephone with its wires was not a telegraph. If that was so the defendants could be forbidden by the landowners over whose lands they desired to place their wires from doing so, as the only power of placing such wires was given on the ground that they were telegraphs within the Act of 1863. And it would, moreover, be *ultra vires* to use the telephone if it was not a telegraph within that Act. Further, the railway companies and those persons who now used wires under a licence from the Postmaster-General, could, by changing their instruments to telephones, laugh at him and evade the monopoly bought at so high a cost. It is said by the defendants that the telephone differed from the instruments that preceded it, as its action depended on different properties; but the same remark may be made as to the needle instruments and the electro-magnetic instruments. Then, again, it is said that with the telephone you have no arbitrary code, and that is said to prevent it from being a telegraph. But suppose one uses the telephone with Morse symbols, would it cease to be a telephone? Yet it would be a telegraph. One could make that code by long and short Ohs! then sing, then speak, where would you draw the line?

Mr. JUSTICE STEPHEN.—Suppose a telephone could not produce a Z. If you sounded D in its place would that make the symbols employed arbitrary?

The SOLICITOR-GENERAL.—As to the scientific evidence, one might well set off one set of scientific men against the other. But why do they say this is not a telegraph? Because it depends on a different

* Specially reported for this JOURNAL by A. B. KEMPE, Esq., Barrister-at-Law.

principle to that of preceding telegraphs. But then Dr. Fleming says that the telephones of Bell and Edison are dependent on different principles; so that if his argument is sound, if Bell's telephone were a telegraph Edison's would not be. No such line can be drawn between any two instruments. The invention of them is a matter of gradual development. At the time of the passing of the Act of 1869 considerable progress had been made. Charles Bourseul had given his ideas to the world. Reis had made his discovery, and Yeates had succeeded in making the voice recognisable at the receiving station. It was clear that the idea of variation, as distinguished from interruption, was known and published by Mr. Varley and Sir W. Thomson, and was turned to actual use in submarine cables. As to the contention that the Company's operations came within the exceptions to the monopoly, that must be argued as if the instruments used were admitted to be telegraphs. The payment made by the subscribers was not only for the use of the wire, but for the services rendered by the switch-boy in connecting the wires, a service which the Company could be compelled to render. It is clear that the subscriptions are in effect a composition in lieu of a payment for each message.

Mr. BENJAMIN, in addressing the Court for the defendants, pointed out that the Postmaster-General had no monopoly of apparatus. His monopoly was solely that of transmitting messages. The preamble of the Act of 1869 indicated the nature of the monopoly. It was to be similar to the monopoly granted in respect of the conveyance of letters by the Act 7th Will. IV. and 1st Vic., cap. 33. That statute made certain exceptions from the monopoly, such as letters conveyed by a friend, or by a messenger employed expressly for the sender's own purposes. There was, however, no exception made in favour of a man carrying his own letters. The reason for that was that the case was not regarded as coming within the monopoly granted, and did not, therefore, require to be excepted. The monopoly was, in fact, that of the employment of intermediaries to convey or transmit the communications of one person to another, and that is also the monopoly granted by the Telegraph Act of 1869. It was never intended that the Postmaster-General should, as had practically been contended, have the monopoly of speech between any two of Her Majesty's subjects. The tactics of the other side had been to pull the unfortunate Mr. Edison's invention to pieces, and to make out that there was nothing new in it. That was not so. The thing was new. In 1869 a "telegraph" was a well-known thing, it was a contrivance for communicating between two persons at a distance by means of a preconcerted code agreed upon by sender and receiver. No author had been or could be cited to show it had any other signification. An author of eminence, M. Jamin, in his "Cours de Physique," vol. iii., page 330, says, in 1869, "La transmission télégraphique exige trois choses: 1° un fil conducteur qui réunit les deux stations et que l'on nomme *fil de ligne* ou simplement *ligne;* 2° un instrument qui lance et interrompt l'électricité dans les conditions déterminées et suivant une signification convenue à l'avance, c'est le *manipulateur;* 3° un autre appareil, le *recepteur*, qui reçoit à la seconde station les signaux envoyés de la première." That clearly shows that it is necessary to have a preconcerted code, and a "making and breaking" of current in order to constitute a telegraph. The telephone required no code and no "making and breaking." Again, Mr. Preece, in a lecture delivered by him [Free Evening Lectures on Scientific Apparatus. Chapman & Hall, 1876] at the South Kensington Museum, had defined telegraphy as "the art of conveying to distant places by the aid of the ear or the eye the first elements of written language. It does not convey from place to place ideas, but the letters of the alphabet and numerals, so that the different systems of telegraphy simply consist in the different ways in which the letters of the alphabet are formed. When that is done by electricity, we have the electric telegraph." And again, after describing the variations of tone created by a boy whilst whistling a tune, he proceeds: "We cannot, in telegraphy, make use of all those variations of tone; we are reduced to simply two notes, one called a *dot*, which is equivalent to a quaver in music; and the other called a *dash*, which is equivalent to a crotchet." That is, in other words, exactly what M. Jamin says, so the two authorities agree. Turning to the statute of 1863, he argued that it was clear from that statute that what was meant by a "message" was a material thing which could be collected, marked, stamped, and deposited. A speech could not be "marked," as was directed in certain cases by the statute. By sec. 21 the property in a message was laid in the Postmaster-General, that clearly implied something material. Wherever the word "communications" was used, it referred to press despatches, which it was no doubt thought could not be properly termed "messages." The Act of 1869, whenever it deals with a private person, always speaks of him as having the "use" of the line, not as sending telegrams. As to sec. 3 of that Act, and its use of "electric signals," no one could say that speaking through a telephonic circuit was signalling, if so, direct speech would be signalling, a *reductio ad absurdum*. The whole idea of transmission implies an intermediary. When one person speaks to another he does not transmit a communication to the latter. The Postmaster-General was claiming a monopoly, and a monopoly should be brought within as narrow limits as possible; and it would be extending the grant to say that it was to apply to cases where there is no "telegram," no transmission of any message by an intermediary, but only direct speech between A and B. The learned counsel then proceeded to point out that at any rate the Company fell within the exceptions of sec. 5 of the Act of 1869. It was clear that since the passing of Lord Brougham's Act (13 & 14 Vic. cap. 21, sec. 4), for shortening Acts of Parliament, which says singular is to include plural, the word *owner* in the exceptions must be read so as to include *owners*. When this is done, we have excepted "telegraphs maintained or used solely for the private use [illegible] of the owners," *i.e.*, the present case. No charge is made by the Company in respect of "collection, receipt, transmission, or delivery," they merely sell or lease apparatus.

At this point the learned counsel, whose voice failed him from hoarseness, was permitted to postpone the remainder of his argument until after Mr. Webster had addressed the Court.

Mr. WEBSTER, following on the same side, said that he must protest against the attempt that had been made to get the Acts of Parliament, upon which the case turned, construed in the light of the expressions which appeared in Mr. Edison's specifications. The Company were not Mr. Edison, and had only a licence from him, and what Mr. Edison had said could not bind them. An attempt had been made to decry the invention, but he challenged the Attorney-General to produce from the annals of patent cases a single case of so perfectly new a result produced by such entirely new means. Before the invention of the telephone the human voice had never been conveyed by wire. All the arguments that had been urged as to the sounders failed, because the sound was produced at the receiving end, and was not generated by the transmitter. It is

obvious that a patent for a monopoly of telegraphic instruments would not cover the telephone. We should have the Postmaster-General claiming the photophone next. Previous telegraphs differed in degree, the telephone differed from them in kind.

Sir J. STEPHEN.—That is too subtle. I once heard a learned debate as to whether the difference between differences of kind and degree was one of degree or kind.

Mr. WEBSTER said that former telegraphs merely signalled, the telephone extended the limits of speech. He then proceeded to deal with the various sections of the Acts of Parliament. He gathered from them that a "message" was something intended to be intrusted by the sender to an intermediary for conveyance, by whatever means, to the receiver. By sec. 15 of the Act of 1868 telegrams are to be charged for by *words*. How could that apply to telephonic communication? The Company merely grant access to certain apparatus for which they make an annual charge. They receive no money in respect of messages or other communications. He also argued that the operations of the Company were within the exceptions.

The telephonic apparatus and mode of operation were then exhibited in Court. In the course of the exhibition, at the request of the Attorney-General, the sentence "a swan was sailing over the sea" was spoken through the circuit. It issued in unmistakable tones as "a wan was wailing over the wee," but a subsequent sentence, "she shut up shop on Sunday," came out equally clearly with the s's correctly pronounced. This was explained to be merely a question of adjustment.

Mr. BENJAMIN then continued his argument. In order to show what was the view of scientific men of ability and knowledge of the subject as to the nature of the telephone he, after some objection by the Attorney-General, read portions of a lecture on the telephone delivered by Mr. Preece at the Royal Institution on February 1st, 1878. Mr. Preece there stated that, "The telephone is an instrument constructed for the transmission of sound to a distance." He (Mr. Benjamin) then asked when the Postmaster's monopoly is infringed. The Company do not ever know whether people are speaking along the wires or not. In order to save wire they adopt the ingenious "exchange system," which requires that they shall when necessary disconnect certain subscribers and connect others. Is that transmitting a message?

The ATTORNEY-GENERAL then replied. He repudiated the idea of having any intention to depreciate the beautiful invention of the telephone. He had done no more than point out its connection with other telegraphic instruments. As to the argument that the monopoly must be construed strictly, he knew of no such rule. Indeed, as the monopoly was for the public benefit it ought if anything to be dealt with in a large and liberal spirit. If the contention of the defendants were correct, that they were owners of a private telegraph within the exceptions, people might club together to any extent and entirely destroy the monopoly. The main points had not been dealt with by the defendants' counsel. They were the existence of the trunk lines and the operations of the switch-boy. How could the Company say that the wires belonged to the individual subscribers or that the Company did not aid in the transmission of messages?

At the conclusion of the Attorney-General's address the Court said they would take time to consider their judgment.

Judgment was delivered on Monday, 20th December. It was in writing, prepared by Mr. Justice Stephen and agreed to by Mr. Baron Pollock.

Mr. JUSTICE STEPHEN, after stating the facts of the case and citing the various definitions of "telegraphs" and "telegrams" contained in the Acts, proceeded to state what the contentions on either side were, and cited various passages from the affidavits, concluding with those which referred to the question, whether sound could be said to be "transmitted" by telephonic apparatus. He then proceeded: We do not think it necessary to express any opinion on a controversy which is more scientific than legal, and perhaps more properly metaphysical or relative to the meaning of words than scientific, as it seems to turn upon the nature of identity in relation to sound. It is enough to say that, whatever may be the merits of the controversy, it does not appear to us that the fact, if it is a fact, that sound itself is transmitted by the telephone establishes any material distinction between telephonic and telegraphic communication, as the transmission if it takes place, is performed by a wire acted on by electricity. We are of opinion, then, that, fully admitting all that has been or indeed can be said as to the novelty and value of the telephonic transmitter and receiver, the whole apparatus, transmitter, wire, and receiver taken together, form "a wire used for the purpose of telegraphic communication, with apparatus connected therewith, for the purpose of telegraphic communication"—that is, they are a telegraph within the definition of the Act of 1863, which is embodied by reference in the Act of 1869. The wire is a wire. The transmitting and receiving instruments are apparatus connected therewith for the purpose of conveying information by electricity; and this, as it seems to us, is telegraphic communication. Indeed, though for scientific purposes it may no doubt be necessary to distinguish between telegraphs and telephones, it seems to us that the word "telegraph," as defined in the Telegraph Acts, is (to use Professor Stokes' words) "wide enough to cover every instrument which may ever be invented which employs electricity transmitted by a wire as a means for conveying information." Indeed, looking to the extension of the definition inserted in the Act of 1869, the words "transmitted by a wire" might probably be left out of this definition. That this view does no violence to the common use of language is proved first, by the fact that in Mr. Edison's own specification the words "telegraph" and "telegraphic" are frequently used in reference to his invention, and that in "Webster's Dictionary," published in 1856, an electro-magnetic telegraph is defined under the head "telegraph," as "an instrument or apparatus for communicating words or language to a distance by the use of electricity," and under the head "electro-magnetic telegraph," as "an instrument or apparatus which, by means of iron wires conducting the electric fluid, conveys intelligence to any given distance with the velocity of lightning." Of course, no one supposes that the legislature intended to refer specifically to telephones many years before they were invented, but it is highly probable that they would, and it seems to us clear they eventually did, use language embracing future discoveries as to the use of electricity for the purpose of conveying intelligence. The great object of the Act of 1863 was to give special powers to telegraph companies to enable them to open streets, lay down wires, take land, suspend wires over highways, connect wires, erect posts on the roofs of houses, and do many other things of the same sort. The Act, in short, was intended to confer powers and to impose duties upon companies established for the purpose of communicating information by the action of electricity upon wires, and absurd consequences would follow if the nature and extent of those powers and duties were made dependent upon the means employed for the purpose of giving the information. Suppose a company found it essential

to erect posts along a highway, and suppose the body having control of the highway gave their consent, would the validity of the consent, and therefore the liability of the parties concerned to an indictment for obstructing the highway, notwithstanding such consent, be dependent on the question whether the messages were sent by an Edison's transmitter or by a Morse key? Or, again, suppose that the company favoured particular customers, and so enabled their friends to get greater advantages in trade or speculation over other persons, could they say, "We have a right to do so, notwithstanding section 41, because we use telephones and not telegraphs?" Or, still more, if one of their clerks negligently refused to send a message or improperly divulged its contents, would they, for the same reason, be deprived of the summary remedy given by section 45? Nearly every section of the Act would supply an additional illustration of the general conclusion that, but for the monopoly established in 1869, the Edison Telephone Company would be as anxious to be included in the Act of 1863 as they are at present to be excluded from it; but this is only an accident, which cannot affect the interpretation of the Act. Looking at the Acts from the point of view of the Crown we are led by a different road to the same conclusion. If a telephone is not a telegraph, then a telephonic communication is not a telegram, and if so any company may not only transmit such messages, but may perform all the incidental services of collection and delivery; and if this is so there is nothing to prevent all the railroad and other companies in possession of telegraphs from applying to them telephonic transmitters and receivers, and carrying on the business of telegraphy just as they did before 1869. The customer would write his message at the counter and the clerk would speak it through the telephone instead of using a less perfect instrument. It is difficult to suppose that the legislature intended to grant a monopoly so liable to be defeated, or that its language was meant to be so construed as to be limited to the then state of, perhaps, the most progressive of all sciences. In this connection we may dispose of one or two minor arguments by which it was attempted to show a distinction between telephonic messages and telegrams. It was said to be essential to a telegraphic message that it should be sent, not direct from party to party, but through the intervention of a messenger or clerk, and also that it should consist of signals having a conventional meaning, and not of actual words spoken. It seems to us impossible to regard these matters as essential to the process. A clerk may be regarded merely as an extra link in a chain of communication, and signals are only imperfect substitutes for words. It would be a strange thing to say that improvements by which a step in a given process can be dispensed with, and by which the process itself may be perfected, destroy the character of the process. To take such a view would be to affirm that imperfections in an instrument are essential parts of it, and that their removal destroys it. Apart from this a practical difficulty arises. There has been a constant progress in the subject of electric communication from its first invention to the present day. Some of the means employed require no code of signals, and some can be worked by any one who can read and write without any assistance from clerks. The A B C instrument worked by moving a hand successively to all the letters forming the message, and this moved a corresponding hand at the other end of the wire. Any two persons who could spell could use these instruments. Hughes' type-printing instrument prints the message in capital letters on a long narrow slip of paper. A telegraph called Cowper's writing telegraph has lately been invented, the nature of which is that a person holding a pen at one end of the wire can write or even draw with it, and that a facsimile is produced by a corresponding pen set in motion by the electric current at the other end of the wire. Two papers were produced before us written in what was said to be Chinese character and exactly resembling each other. The one was written by a Chinese lady and the other by the pen at the other end of the wire.* Now, either these instruments are telegraphs, and the messages sent by them telegrams within the Act, or they are not. If Cowper's writing telegraph is within the Act it is difficult to say why a telephone is not. They equally dispense with clerks or messengers. If the sound is in any sense transmitted in the one case, the motions of the hand are in the same sense transmitted in the other. The one reproduces actual written words quite as accurately as the other reproduces words spoken; and if the one can properly be described as a complicated speaking trumpet, the other can with equal propriety be described as an elongated pen. If, on the other hand, Cowper's writing telegraph is not within the Act, it is equally difficult to say why Hughes' type-printer is within it. It requires no messenger or servant at least at the receiving end, and it employs no special code of signals. It is, however, impossible to doubt that it is included, for it was in common use long before the Act of 1869, having been invented in 1854, and having procured the Grand Prix for its inventor at the Paris Exhibition of 1867.† The result seems to be that it is impossible to draw the line between these instruments, and that all or none must be regarded as coming within the definition of the term "telegraph" so often referred to. For all these reasons we hold that a telephone is a telegraph within the meaning of the Acts of 1869 and 1863. The second point made by the defendant Company was that, whether the telephone was a telegraph or not, the conversations held through it were not "messages or communications" sent by a telegraph within the meaning of the Act. This contention was founded partly on the argument that the directness of communication between the parties to the conversation rendered the word "message" inappropriate, and partly on the Telegraph Acts of 1863 and 1868, which, it was said, use the word "message" in the sense of a substance with a message written upon it, and on the Telegraph Act of 1869, which, it was said, uses the word "communication" in a peculiar sense. As to the word "message," it is, no doubt, true that in several sections it is so used; but in others it seems to us to be used in the sense of the purport or tenour of the message. It is, for instance, an offence to delay to "transmit or deliver" a message. "Transmit" obviously applies to the words and not to the paper; "deliver" to the paper and not to the words; and so in other cases. The same remark applies to the Act of 1868, in which the word "message" is frequently used, and which was commented upon by Mr. Webster minutely. All the difficulties raised or attempted to be raised appear to us to be capable of solution by the single principle already stated. The word "communication" in the definition of "telegram" given in the Act of 1869 was said to have found its way there from sec. 16 of the Act of 1868, which authorises the Postmaster-General to make contracts with the proprietors of newspapers and others for the transmission or delivery of "telegraphic communications" to them at certain times and on certain terms, and it was rather suggested than expressly argued that such communications only would

* This was done by Arlincourt's telegraph.
† Hughes' telegraph is referred to in the Act of 1868, sec. 8.

be telegrams within the meaning of the definition of the Act of 1869. We do not agree with this view. The use of the word "communication" instead of message in sec. 16 of the Act of 1868 certainly favours the opinion that there might be communications which would not be properly described as messages, but there is nothing in the definition of a telegram in the Act of 1869 which suggests that the word "communication" which it contains is to be restricted to the communications mentioned in sec. 16 of the Act of 1868. It is very possible that the use of the word in the one section may have suggested its use in the other, but there is nothing to narrow its sense in the last-mentioned section. For these reasons we hold that a conversation held through a telephone is either a message or, at all events, a communication transmitted by a telegraph, which is the definition of a telegram. A small question was raised on the word "transmitted." When one person speaks to another it was said he "makes," but does not "transmit," a communication. The answer is that when he speaks through a wire some miles long he sends what he says through the wire, or transmits it. As the defendants contended that the very voice itself was so sent, this seems specially clear as against them. It was further argued that, admitting the conversations in question to be telegrams, they were still not within the Act of 1869, because the preamble of that Act recites that "similar powers to those conferred upon the Postmaster-General with respect to the exclusive privilege of conveying letters should be enacted with reference to the transmission of telegraphic messages." This, it is said, confines the exclusive privilege as to telegrams within the limits within which the exclusive privilege as to letters is confined, and subjects it to the same tacit exceptions. But the exclusive privilege of the Postmaster-General as to letters is "the exclusive privilege of conveying from one place to another all letters" (6 and 7 Wm. IV., chap 33, sec. 2) subject to certain exceptions. No express exception applies to the case of a man who carries his own letter with his own hand to the person to whom it is addressed. Yet this exception has always been regarded as tacitly implied in the Act, and no one ever supposed that a man who came within it violated the Postmaster-General's exclusive privilege. It was argued that, in like manner, if two friends communicated with each other directly by a telegraph of which they were joint owners, they would be outside of the sphere of the Act of 1869. To this argument there are, in our opinion, several conclusive answers. In the first place, we do not think that the recital in the preamble of the Act of 1869 ought to have the effect ascribed to it. Each Act must be construed independently. The practical inconvenience of construing the Post Office Act literally would be so very great that it can never have been seriously proposed so to construe it. It is enough to say that such a construction would have involved the consequence that when a letter was written it must be left on the table at which it was written till the postman called and took it away, visiting every room in every house for that purpose. Such a consequence is an absurdity, but there is no absurdity in supposing that the legislature meant to prohibit private electric telegraphs. The extent to which they were intended to be prohibited will appear from the exceptions to be considered immediately. In the next place, there is no real analogy between a man carrying his own letter to his correspondent's house and two men telegraphing to each other. In the one case the act done can by no conceivable means injure the revenue. In the other case, an apparatus must be employed which may readily be made to injure the revenue. The object of the Post Office Act is to give to the Postmaster-General an exclusive right to earn all that can be earned by carrying letters, but a man cannot pay himself for carrying his own letter. If he gets a friend to carry it for him he might pay, and this case is accordingly provided for by an express exception. In the third place, the customers of the Telephone Company do not in fact communicate directly with each other. They are put in communication by a servant of the Company, and their messages travel in all cases over at least one wire, and in many cases over three separate wires which are the property of the Company. On all these grounds we hold that the conversations held through the telephone are infringements of the Postmaster-General's exclusive privilege unless they can be shown to be within the exceptions to that privilege. We now pass to two exceptions. Those which are said to apply are the first and second in section 5 of the Act of 1869. The first is in these words—"Telegrams in respect of the transmission of which no charge is made, transmitted by a telegraph maintained or used solely for private use, and relating to the business or private affairs of the owner thereof." The second is—"Telegrams transmitted by a telegraph maintained for the private use of a corporation, company, or person, and in respect of which, or of the collection, receipt, and transmission, or delivery of which no money or valuable consideration shall be or promised to be made or given." These exceptions resemble each other so closely that it is not easy to put a case of a telegram which would fall within the first exception and which would not fall within the second. Every "telegraph maintained or used solely for private use" must be a "telegraph maintained for the private use of a company, corporation or person." A "telegram for which no charge is made" does not differ materially from a "telegram in respect of which, or of the collection, receipt, and transmission of which no money or valuable consideration shall be or promised" (the words "shall be" seem to be wanted before "promised") "to be made or given." And a message "relating to the business or private affairs of the owner" of the telegraph by which it is sent is a telegram. Thus the second exception seems to contain everything which can fall within the first and nothing more, except possibly telegrams not charged for transmitted by a telegraph used solely for private use and relating to the business of the owner of the telegraph, such telegraph not being maintained by the owner. But no case occurs to us in which a man is likely to own a telegraph and use it exclusively for his own business and yet not to maintain it. It was suggested that one of these clauses was added by way of amendment as the Bill passed through Parliament. It may be so, but it is difficult to conjecture what the object of the amendment can have been. Whatever may have been the history of the two exceptions the meaning of the first of them is in one point obscure. It authorises individuals to keep telegraphs for their own use and to send messages by them relating to their own affairs so long as no charge is made for the messages. This condition is to us unintelligible. How could a man make a charge to himself for sending a message on his own telegraph about his own affairs? It seems as if the exception had been originally intended to provide for two classes of telegrams, sent by telegraphs maintained or used solely for private use—namely, first, telegrams relating to the private affairs of the owner; and, secondly, telegrams relating to other people's affairs, sent as an exceptional favour and not charged for; but this is certainly not said. The second exception provides not only for most of the cases provided for by the first exception, but also for the case which seems to have been, for some reason, omitted from the

first exception. The telegrams to which the second exception refers may relate to any subject so long as they are not charged for and so long as the telegraph by which they are sent is maintained for the private use of any corporation, company, or person. Upon the whole the effect of the two exceptions seems to us to be that if a person, company, or corporation has a telegraph maintained *bonâ fide* for his or its own use—if, for instance, a banker has a telegraph to communicate between his office in the city and another office in a distant part of London, or if under the Act of 1868 (sec. 9, 8) a railway has made arrangements with a coal master upon the company's system for a private telegraph between his coal pit and a station, they may not only send telegrams on their own affairs, but may also, under special circumstances, and if no charge is made, send messages on the affairs of others. This view of the exceptions shows how wide the exclusive privilege granted to the Postmaster-General was intended to be. But for them it would be unlawful for the owner of works spread over a great space of ground to have a telegraph to communicate between the different parts of the establishment, or for a man of business with two offices in different parts of London to have a telegraph between them. This supports what we have already said as to the difference between the exclusive privilege of the Postmaster-General in relation to telegrams and in relation to letters. The privilege relating to telegrams seems to us to be the wider of the two. It was argued by the defendants that they were within the first exception, because in it the word "owner" ought to be read as including "owners," the effect of which was said to be that two persons might contribute to keep up a telegraph, and use it for communicating with each other on affairs interesting to either, that each of them might again communicate with others, and that thus the country might in theory be covered with a network of telegraphic wires, each connecting two persons only. It was further suggested that if this were lawful, it would be lawful in order to avoid circuity and complication to consolidate the individual wires into a small number owned by a large number of subscribers, and this it was said was practically what was done by the defendant Company. This ingenious argument appears to us to be unfounded both in law and in fact. The exceptions seem to us to apply exclusively to telegraphs kept either by a single owner or under one express provision of the Telegraph Acts, like the one already referred to; but, quite apart from this, it is obvious that the telegraphs of the defendant Company are neither owned nor maintained by the subscribers, nor are they used solely by the owners. The switch board and the trunk wires are the property of the defendant Company, and they are essential to the system of communication adopted. Moreover, a charge in the shape of rent is made for the transmission of messages, and from this the Company derives a profit. Each of these circumstances takes the case out of the exceptions, or rather prevents them from applying to it. Lastly, it was asked by the defendants when and by whom the offence, if any, of the defendant Company, was committed. To this we think the answer is—that if several persons combine to do an illegal act each is guilty of the whole of it, so that when A sends a telegram to B by means provided by the Company for that purpose and under the provisions of a contract by which it is carried out, A, B, and the Company are all guilty of an offence under section 6 of the Act of 1869—namely, the offence of transmitting a telegram. Apart from this, we think that when the Company's servant puts A in telephonic communication with B, the Company aids and is concerned in transmitting a telegram, which, again, is an offence under the same section. The result is, that we give judgment for the Crown, with costs There will, accordingly, be declarations in the terms of paragraphs 1 and 2 of the prayer, an injunction in the terms of paragraph 3, and an order that an account be taken as in paragraph 4.

Mr. WEBSTER, on the part of the defendants, intimated that there would be an immediate appeal, and the injunction was ordered to stand over until its determination.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXIV.

THE WHEATSTONE AUTOMATIC SYSTEM.

(Continued.)

FIG. 90 shows a general view of the controlling mechanism of the transmitter, whose action was explained by figs. 87, 88, and 89, in the last article. The star wheel which draws the punched slip from right to left is seen at the top of the steel rods, S, M, and lies between them. A small roller, R, with slots cut in its circumference which receive the teeth of the star-wheel, is pressed down on the paper slip by means of a spring, and keeps its movements steady. Fig. 91 shows the arrangement in detail. The star-wheel, which is turned by the same train of clockwork which actuates the rocking lever, Y, is so geared that the up and down movements of the rods, S, M, take place exactly when the perforations in the paper slip come opposite the ends of the rods.

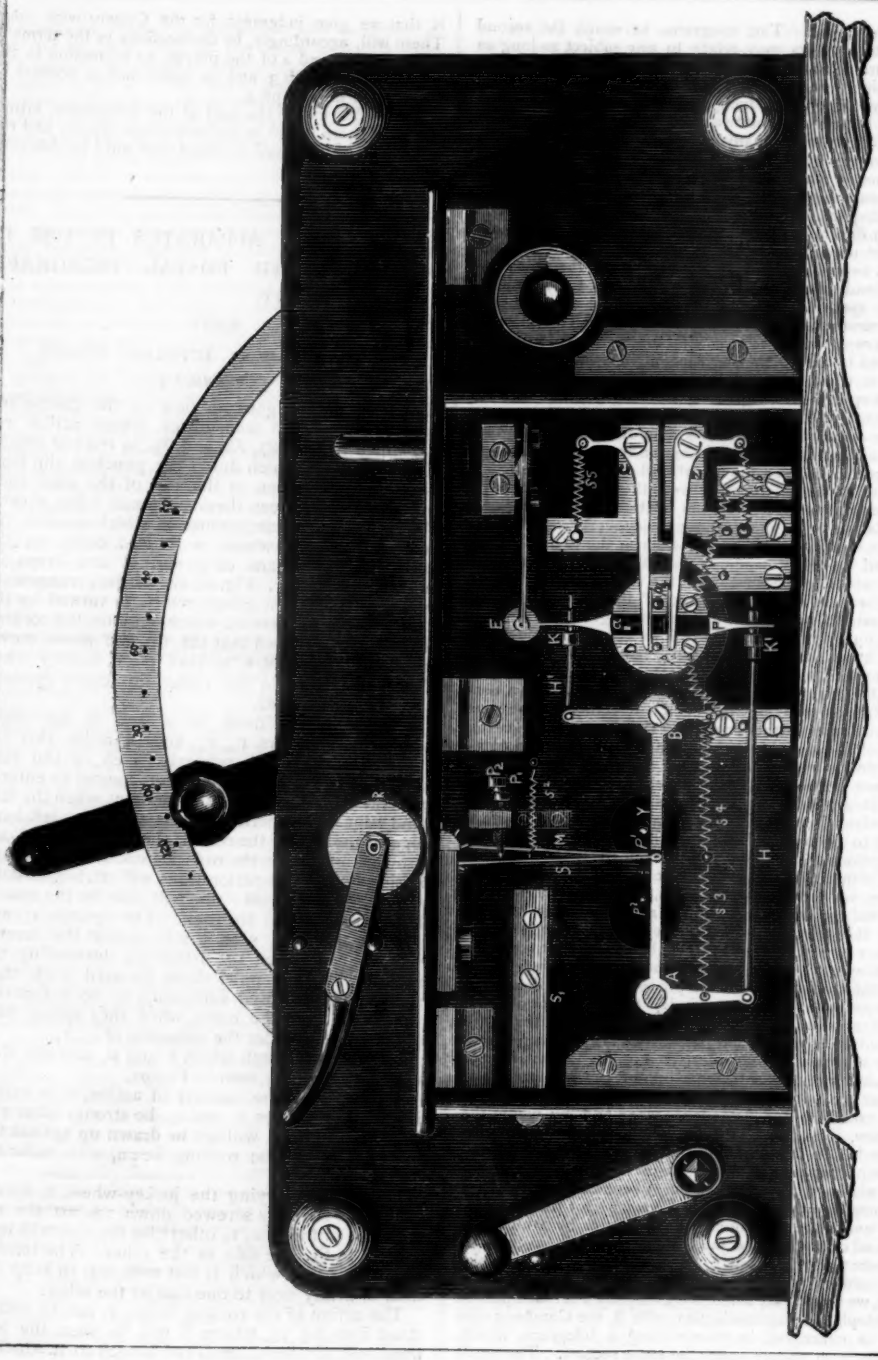
The exact positions of S and M are regulated by the screws, P_1, P_2, and in order that the apparatus may work properly, each of the rods should be so adjusted that it commences to enter a perforation in the slip at the moment when the left-hand edge of the perforation is over the left-hand edge of the end of the rod. If the screws, P_1, P_2, are screwed out too far, the rods, instead of entering and passing through the perforations, will catch against the edges and be stopped; this will also be the case if the screws are too far back. The springs, s_1, and s_2, keep the rods, S, M, firmly against the screws, P_1, P_2, except when the latter are descending, the moving slip then pulls them forward until they have become lowered sufficiently to be withdrawn completely from the holes, when they spring back against P_1, P_2, under the influence of s_1, s_2.

The holes through which S and M, and the star-wheel, pass will be seen in Fig. 92.

In order to insure rapidity of action, it is essential that the springs, s_3 and s_4, be strong, otherwise the levers, A and B, will not be drawn up against the pins, p_1, p_2, on the rocking beam, with sufficient rapidity.

The spring carrying the jockey-wheel, E, should not be too strongly screwed down against the top tail-piece of the disc, D, otherwise the disc will tend to stick to the one side or the other. The tension required is that which is just sufficient to keep the disc, D, firmly over to one side or the other.

The action of the rocking-beam, Y, can be understood from fig. 93, where it will be seen the left-hand end of Y has a small rod hinged to it which is


E
K
K'
H'
H
B
A
S
S1
S2
S3
S4
S5
M
Y
P
P1
P2
R
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
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R85
R86
R87
R88
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R90
R91
R92
R93
R94
R95
R96
R97
R98
R99
R100

FIG. 90.

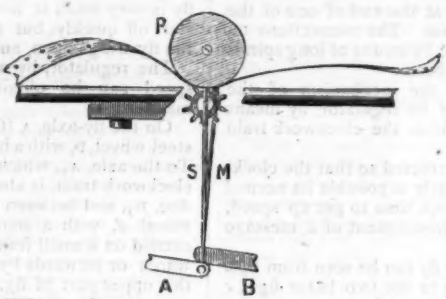


FIG. 91.

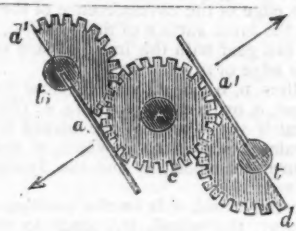


FIG. 95.

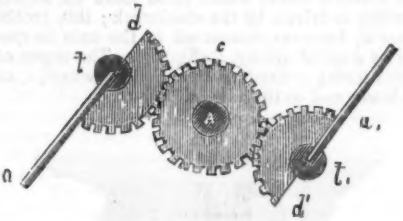


FIG. 96.

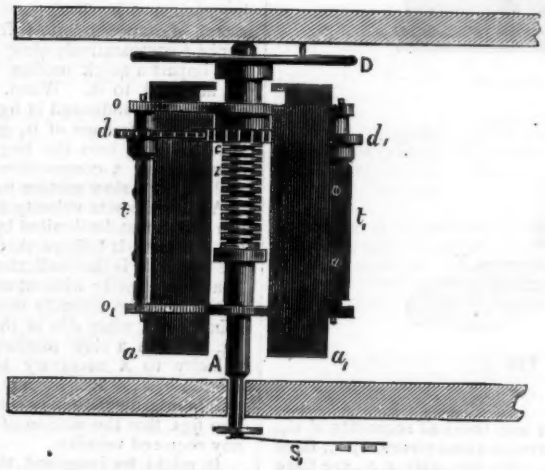


FIG. 94.

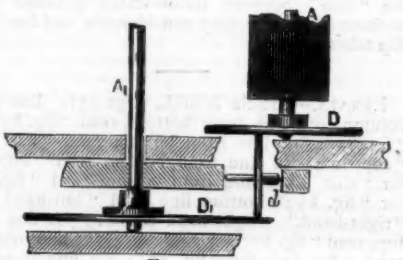


FIG. 97.

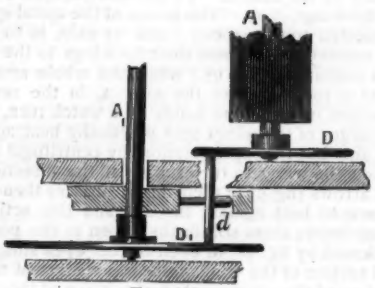


FIG. 98.

worked by a crank-pin set at the end of one of the axles in the clockwork train. The connections on to the pins, p_1, p_2, are made by means of long spirals of wire at the back of the beam.

An important part of the mechanism of the apparatus is the "fly" and its regulator, by means of which the speed at which the clockwork train runs can be regulated.

The fly is specially constructed so that the clockwork can start off at as nearly as possible its normal speed. If the apparatus took time to get up speed, several signals at the commencement of a message might be lost.

The construction of the fly can be seen from figs. 94, 95, and 96. Referring to the two latter figs., *c* is a toothed wheel which turns loose on an axle, A, which is driven by the clockwork; this toothed wheel is, however, connected to the axle in question by a spiral spring, *z* (fig. 94). The upper end of this spring is fixed to the toothed wheel, *c*, and the lower end to the axle, A.

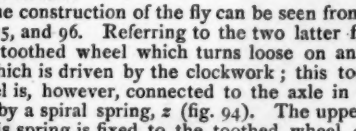


FIG. 92.

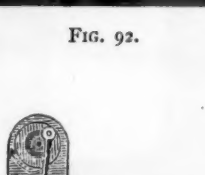


FIG. 93.

The wheel, *c*, gears into two half segments, *d*, d_1, whose axles, *t*, t_1, turn in cross-pieces, *o*, o_1, fixed rigidly to the axle, A. To the axles, *t*, t_1, are fixed the fly-wings, *a*, a_1. The action of the spiral spring connected to the wheel, *c*, and its axle, is to turn the segments, *d*, d_1, and their fly-wings to the position indicated in fig. 95; when the whole arrangement is rotated about the axle, A, in the reverse direction in which the hands of a watch turn, then the edges of the wings only practically beat against the air; but the rapid rotation, by centrifugal force, causes the wings to turn round in the direction of the arrows (fig. 95); their inside surfaces then commence to beat against the air, and this action at once throws them still further open to the position indicated by fig. 96, or even further open still. The full surface of the wings thus being exposed to the surface of the air, the speed of rotation of the clockwork is kept in check.

It will thus be seen that the check-action of the fly is very small at first, so that the clockwork can start off quickly, but as soon as speed is attained the fly-wings open, and a full check is put on.

The regulator, by means of which any required speed can be obtained, acts in the following manner:—

On the fly-axle, A (figs. 94, 97, 98), is fixed a solid steel wheel, D, with a brightly polished outer surface. To the axle, A_1, which is directly in gear with the clockwork train, is also fixed a bright steel wheel or disc, D_1, and between D and D_1 a third loose steel wheel, *d*, with a smooth edge. The axle of *d* is carried on a small frame, which can be shifted backwards or forwards by means of the handle seen at the upper part of fig. 90; thus *d* can be made to gear near the edge of the circumference of the disc, D_1, and near the inner surface of the wheel, D, as in fig. 97, or it can gear with the inner surface of D_1, and the outer edge of D, as in fig. 98.

Now the discs, D, D_1, being kept in close contact with the wheel, *d*, by means of a spring, S_1 (fig. 94), it follows that if the wheel, D_1, be turned by the clockwork train, it will turn the wheel, *d*, and the latter will turn the wheel, D, and the fly-axle on which it is fixed.

Now when the wheel, *d*, is in the position indicated in fig. 97, the wheel, D_1, tends to turn it rapidly, since we have a large circumference gearing against a small circumference. Similarly, the wheel, *d*, tends to turn the wheel, D, quickly; hence a comparatively slow motion of the axle, A_1, will impart a quick motion to the axle, A, and the fly attached to it. When, however, the state of affairs is that indicated in fig. 98, then we have the small circumference of D_1 gearing into *d*, and the latter gearing into the large circumference of D, consequently a comparatively quick motion of A_1 will impart a slow motion to A.

As the ultimate velocity at which the clockwork can turn must be limited by the rate at which the fly can turn, it follows that when the position of the wheel, *d*, is that indicated in fig. 98, A_1 can turn at a high velocity without moving A at such a rate as to check the ultimate motion of A_1; and, on the other hand, when *d* is in the position indicated in fig. 97, then a slow motion of A_1 will impart the velocity to A necessary to check the ultimate motion of A_1. It is evident, also, that if *d* be set at points intermediate between those indicated in the two figs. that the motion of A_1 can be regulated to any required velocity.

It might be imagined that the wheel, *d*, would slip instead of turning with the wheels, D, D_1, but the "bite" between unlubricated polished steel surfaces is actually very considerable, and but little slip takes place.

ERRATA.—Article XXIII., page 431. Left-hand column, 9th line from bottom, read "fig. 89" for "fig. 87"; 8th line from bottom read "zinc" for "copper"; 7th line from bottom read "copper" for "zinc"; 5th line from bottom read "fig. 87" for "fig. 89;" bottom line read "left-hand" for "right-hand." Right-hand column, 5th line from top, read "fig. 87" for "fig. 89"; 7th line from top read "fig. 89" for "fig. 87"; 8th line from top read "zinc" for "copper"; 9th line from top read "copper" for "zinc."

Notes.

THE TELEPHONE.—The telephone case is for the present finished, and now the postal authorities are preparing to supply the public with telephonic intercommunication. H.M. Postmaster-General has ordered of the Gower-Bell Telephone Company 20,000 telephones, and the Postal Telegraph Department has already received many hundred applications for the instalment of that instrument. Any attempt on the part of the United Telephone Company to pose as injured inventors is absurd, for the original inventors are but slightly interested, in a pecuniary sense, in it; Prof. Graham Bell perhaps to the extent of one share, and we believe Mr. Edison not at all. Besides, the Department has made very fair and liberal terms with the Gower Company, in the profits of which the United Company is largely interested, so that it seems probable that the latter may make a much larger profit now the Government have taken up the telephone than it would have done under its own erratic management, and certainly more than it has done in the past. We learn that circulars and recriminations are freely passing in the camp of the United Company, and that a meeting is called for the 13th instant. Among the advantages to be named consequent on the Post Office letting out telephones is, first, the lower price at which the rental is placed (£15 as compared with £20); second, the connection being made with the general telegraph system; and, third, the fact that probably more underground wires, instead of the unsightly and dangerous overhead wires, will be used than would have been the case under the older system.

WE understand that a revised and enlarged edition of Mr. H. R. Kempe's "Handbook of Electrical Testing" is now in the press and will shortly be published by Messrs. E. & F. N. Spon.

TWO NEW ATLANTIC CABLES PROPOSED.—It is probable that a company, to be called the American Union Cable Company, will soon be organised for the purpose of laying two Atlantic cables, which will be operated in connection with the American Union Telegraph Company. Estimates for the construction of the two new cables have been received in this city. The cost of construction is understood to be less than £1,500,000, and it is probable that Siemens & Co. will be given the contract for the work. It is proposed, if the cables are laid, to land them on the American side at Whitehead Bay Harbour, in Nova Scotia, just east of Torbay. The English end will be near Penzance. So says the New York *Operator*.

The New York *World* gives the following correspondence on the same subject:—

"London, Dec. 11.

"Have just returned after eight weeks' absence in the Mediterranean, where I have been endeavouring to give an international character to the whole of our system of submarine telegraphs, and with considerable success, an idea which I am anxious should be participated in by the great American telegraph system. The French cable, properly worked, should meet all the requirements of your own company for the moment. To spend more money in laying new cables at present would be equally disastrous to the new as to the present systems. I am hopeful that the French cable will be put into a thoroughly efficient working state so soon as the agreement with us is ratified. I shall do all in my power consistent with any existing obligations in order to bring about such an arrangement as will satisfy the requirements of your traffic. My visit to America is only delayed. It is my full intention to come out in the spring. The French Company's meeting for confirmation of the agreement is to be held Jan. 12 next.

"JOHN PENDER, London.

"Jay Gould, New York."

"New York, Dec. 12, 1880.

"Your despatch received. As an evidence of my entire friendliness to your interests, I carefully communicated through Mr. Ward to you some weeks since the concessions our large interests on this side required from the existing cables, and at the same time I informed him that unless these were granted we should lay our own cables. Having received unfavourable responses, I accordingly opened subscriptions for two new cables. The entire amount is subscribed, and we shall proceed to lay them. At the same time I cordially reciprocate your sentiments as to international telegraphy, and will do my share towards its vigorous and rapid development by laying independent cables.

"JAY GOULD, New York.

"John Pender, London."

The following particulars are also taken from an American newspaper:—

"Subscriptions for the construction of two new cables have been opened by the Central Construction Company. The fund which is to be raised is 6,000,000 dols., of which one-half will be reserved for the subscribers of the Central Construction Company of record on September 15th last. The calls on the subscribers will be 10 per cent. of their subscription at a time. For every 1,000 dols. paid up the subscribers will receive ten shares of stock of the value of 100 dols. each and a 1,000 dols. 6 per cent. mortgage bond. The privilege to subscribe will expire on December 31st, 1880. The contractors for the new cables will be Messrs. Siemens and Co., of England. The American end of the cables will be at Whitehead Bay Harbour, just east of Torbay, in Nova Scotia, the landing on the English side to be made near Penzance."

THE Board of the West Coast of America Telegraph Company, Limited, inform us that in consequence of the continuance of the war between Chili and Peru, they are obliged to defer payment of the coupons on the debentures of the company, due on the 31st of December

THE s.s. *Scotia*, which left London on the 18th ultimo, to raise and repair the Brest Cable (1869) broken on the 12th November last, has put into Plymouth for orders. The Telegraph Construction and Maintenance Company's engineer reports, that after picking up the eastern end of the cable at 220 miles from Brest, the weather became too boisterous to justify him in the expectation that further operations could be continued during the winter with any reasonable prospect of success. Under these circumstances the directors have decided to postpone the repair until next spring.

WE are requested to state that Joel's improved incandescent lamps, recently described in these columns, can be obtained at the Electric Light Agency's offices, 52, Queen Victoria Street, where they can be seen at work.

THE Edinburgh Rosebank Iron Works, which have been for some time experimentally lighted by a Crompton lamp, are now about to be permanently lighted by three of those lamps.

THE first public telephone line in Germany was opened a few days ago by the Berlin Telegraph Office.

PHILADELPHIA newspapers report that the American Union Telegraph Company are about to try in that city the experiment of putting their wires underground. The plan works well enough in European cities, and there would seem to be no reason why it should not succeed here, save the indisposition of the companies to bear the first cost of making the change. For some months the Western Union Telegraph Company has had the matter under consideration, but will probably wait until pressed by a rival company before it undertakes the more serious task of taking down its forest of poles and sinking the wires which contribute so much to the prevailing ugliness of our streets. Sooner or later the poles and wires must come down, and it is altogether probable that the change will be beneficial to the companies in the long run, owing to the smaller cost of maintaining a subterranean system. It will certainly be an advantage to the community.—*Scientific American.*

AT a recent meeting of the Mersey Docks and Harbour Board it was resolved to adopt the electric light at a portion of the new dock system at the north end of the city, at an estimated cost of £2,000. This is to be an experiment, and upon the result will depend the extension of the light over the docks generally.

THE TELEPHONE.—Mr. Rolls, of the South-Western Railway Telegraphs, has lately been carrying out some experiments with the Gower-Bell loud-speaking telephone which have proved remarkably successful. In the first place the instrument was tried over sections of varying lengths as a means of verbal communication between signal cabins, a noteworthy point in the experiments being that the block wire itself was the only connection between the distant points, Mr. Rolls placing the telephones in multiple circuit with the block instruments at each end, between line and earth, in such a manner as in no wise to affect the block working; in fact, while listening at the telephone a train passing the distant cabin could be heard simultaneously with the receipt of the ordinary signals upon the block instrument indicating the train's departure. The movement of the levers placing signals on behind the train five miles away could also be distinctly heard. Conversation was carried on with the utmost ease by inexperienced persons, and all sounds were remarkably clear, although several through postal wires worked by powerful currents ran on the same set of poles. This form of telephone having proved so successful, it was subsequently tried as a long circuit speaking instrument between Yeovil and Exeter, a distance of forty-nine miles, upon the same set of poles as before; and despite the usual effects of induction, the voice was as remarkably predominant and as clearly and distinctly heard as in the previous experiment over a short section. Further trials indicated that the distances mentioned might be at least doubled.

MR. CROMPTON has contracted to illuminate with electric light the Bricklayer's Arms goods station of the South-Eastern Railway Company. He is also entrusted with the lighting of the Glasgow Post Office and the goods station of the North British Railway. The winter contract for the Alexandra Palace is likewise placed in his hands.

IT seems probable that in another two or three months nearly all the principal railway stations in London and many of those in the country will be electrically lighted. Indeed so rapidly does demand now follow on demand for the necessary apparatus that all the existing manufacturers must ere long be overpressed with orders.

A METHOD FOR PRODUCING THE LIGHT-PHENOMENON OF GEISSLERS' TUBES.—L. Weber.—A U-tube whose limbs are about 770 millimetres in length is filled with mercury, inverted and placed with its limbs in two capsules filled with mercury and connected with the ends of an induction-coil.—*Wiedemann's Beiblätter.*

ON THE PERMANENT MAGNETISM OF HARD STEEL AND THE INFLUENCE OF CONCUSSION.—H. Kulp.—Hard pieces of steel were permanently magnetised and the decrease of the permanent magnetism was observed on their being submitted to concussion. The same process was repeated three times. The magnetism was never inverted as is the case with soft iron. The decrease is the smaller the greater the original magnetism. Soft iron behaves in a manner exactly opposite.

ON AN AUTOMATIC COMMUTATOR FOR ELECTRIC LIGHTS.—A. A. de Pina Vidal.—The author has devised an appliance which exchanges the Jablochkoff candles when burnt down.—*Jornal de Sciencas Math. Phys. e Nat.*

EXPERIMENTAL INVESTIGATIONS OR CHANGES IN THE ABSOLUTE TENACITY OF IRON WIRES PRODUCED BY THE ELECTRIC CURRENT.—G. Hoffmann.—An increase of tenacity was observed in iron wires after being traversed by the current. Wire which in its original state was able to support 2,363 grm. after a three hours' passage of the current supported 2,391, showing an increase of 28 grm. With the prolongation of the action of the current the increase of tenacity became greater till it attained a maximum which was reached earlier in some wires and later in others. Thus wires of 0·19 millimetre in thickness after a three hours' passage of the current showed an increase of tenacity = 28 grms., after 12 hours', 44, and after 24 hours' 50; another wire of 0·31 millimetres in diameter after three hours showed a gain of 12 grms., after 12 hours, 23 grms., and after 24 hours no further increase. With feeble currents the increase of tenacity in equal times is almost proportional to the strength of the current, but for stronger currents this law is no longer available owing to the heating of the wires. Thus in the wire of 0·19 millimetre diameter a 12 hours' passage of a current causing a deviation of 4° gave an increase of strength = 20 grms., one of 6° = 29 grms., and one of 9° = 44 grms. During the actual passage of the current the increase was greater. The author considers that the increase of cohesion is favoured by the heat evolved by the current, but that the current itself plays an essential part.—*Wiedemann's Beiblätter.*

HIPP'S COMPASS FOR THE MEASUREMENT OF STRONG CURRENTS.—E. Hagenbach. Hipp employs a simple compass with a needle playing upon a point. Beneath the latter a strip of copper, 20 millimetres in breadth and 1 millimetre in thickness, is made to pass and return, the two superimposed halves being isolated from each other by a piece of cardboard. On the passage of currents the deviations of the needle correspond to the differences in their action.—*Zeitschrift für Angewandte Electricität* 2. P. 64.

MANAGEMENT OF BUNSEN ELEMENTS.—L. Beilstein and F. Jawein. In order to prevent the oxidation of the conductive wires, binding-screws, &c., they are rubbed over with oleonaphtha prepared from Caucasian petroleum. The resistance is not perceptibly increased. Other mineral oils would act in a similar manner.

THERMO-CHEMICAL RESEARCHES.—Julius Thomson. The author gives in Kolbe's *Journal für Praktische*

Chemie the values which he has calculated for the energy of different galvanic combinations. Zinc, sulphuric acid, sulphate of copper, and copper being =1·00; zinc, sulphuric acid, monohydrated nitric acid, and carbon =1·92; and zinc, sulphuric acid, chromic acid, and sulphated carbon =1·99.

ON THE THEORY OF THE VOLTAIC CIRCUIT.—G. Cantoni. The author compares circuits with a motor, driven by water or steam, in which motion is occasioned by a difference of pressure, which is continually renewed, and consequently presupposes a permanent circulation of the water or the steam. As in the case of steam, water is also raised by the energy of heat (the sun's rays). In thermo-electric combinations the required difference of pressure depends on the difference of the electric potential at the point of contact of the heterogeneous elements, to which a source of heat is approached. The heat at the point of contact is converted into electricity, which moves in the circuit with an energy proportional to such difference, so that the intensity of the current corresponds to the quantity of heat converted into electricity in a unit of time.

In a friction machine in the same manner the potential difference at the point of contact and the quantity of heat expended in maintaining the speed of the bodies rubbed together and separated from each other must come into play.

In the galvanic element the energy (heat), which is partially transformed into electricity, depends on the chemical processes which in the first place effect merely a rise of temperature. By the potential difference at the points of contact it acquires, according to Cantoni, a direction. A simple potential difference between two bodies can only give the first impulse in a given direction between the elements of a closed electric circuit. It could not produce a current capable of continually overcoming outward and constantly renewed resistance if the impulse were not renewed by a permanent source of heat in consequence of the internal chemical processes. As in the thermo-circuit, only that part of the heat which circulates in the element is utilised in the current which is thus called forth by chemical action electrically directed.—*Wiedemann's Beiblätter.*

AN interesting relic of the early days of telegraphy has been discovered at Morristown, N. J. It is the first instrument by which messages were received and sent by aid of the electric current, and was one of two taken from Morristown by Morse and Vail—Morse using one at Washington, and Vail the other at Baltimore. The first message sent was the now well-known "What has God wrought?" which Morse transmitted to Vail; but the first public message was the news of the nomination of Polk to the presidency by the Baltimore convention of 1844, sent by Vail to Morse. These instruments were in constant use for six years when Mr. Vail, returning to Morristown, brought his with him, and where it has still remained in the possession of his family. Mr. Vail dying soon after, his instrument was specially left by a clause in his will to his eldest son as an heirloom, while parts of instruments made during the experimental trials were left to Professor Morse, with a request that he would give them at some future day to the New Jersey Historical Society. The old instrument works as well as when first made. Its dimensions are 16 inches in length, 7 inches in height, 6 inches wide, with two magnets of 3 inches diameter. The paper used was 2¼ inches in width, three pens being proposed to be used. The weight of the instrument is twenty pounds.—*From "Telegraphic Tales and Telegraphic History."*

MR. SWAN has been elected President of the Newcastle-on-Tyne Chemical Society. At his introduction Mr. Swan delivered an address, in which he dealt with the use of electricity as an agent for fusing the highly refractory metals.

M. GASCO has applied electricity as a motive-power to a portion of the Turin-Modena Railway, a length of 200 metres. The dynamo machine is worked by hydraulic power.

THE Government of India have requested the Indian Chamber of Commerce to furnish their opinions as to the inauguration of the telephone system in India. This request is based on the application of the Bell Telephone Company for permission to work the Edison and Bell system in India.

M. BLONDLOT finds that when a piece of annealed selenium is connected to one pole of a Lippmann capillary electrometer, by means of a platinum wire, and a plate of platinum is similarly connected to the other pole, a comparatively powerful electric current is developed by rubbing the selenium against the platinum plate.

DR. UELSMANN finds that silicum iron may be used as the negative element in a nitric acid battery, as this substance is passive in the acid.

THE sorting office and instrument gallery of the Glasgow Post Office have recently been lighted by the Crompton electric light. The rooms are peculiarly adapted for electric lighting. Two lamps of 4,000 candle-power each and worked by two dynamo machines were used. Every part of the instrument room was well lit, and the temperature, which with gas at 7 P.M. was 66½° F., fell to 62° F. at 8.40 P.M., the electric light being started at 7.25 P.M. In the sorting gallery the temperature fell from 66° to 64°. The verdict of the employées was unanimously in favour of the new light, and it is stated that several sorters dispensed with their spectacles whilst engaged in their duties, and that they felt much fresher and free from any feeling of headache than usual.

THE PARIS EXHIBITION OF ELECTRICITY.—It is now finally settled that this exhibition will be held in Paris, in the palace of the Champs Elysées, opening on the 1st August, 1881, and closing on the 15th November following. Applications for space will have to be made not later than the 31st March next to the Commissionare General at Paris. The exhibition will be divided into the following groups:—Apparatus employed for the production and transmission of electricity; natural and artificial magnets; physical electrical apparatus; exhibits of the applications of electricity to industrial purposes, such as the transmission of signals and sound, the production of heat and light; its employment in the service of lighthouses, in mines, railways, and navigation; its adaptation to military purposes, fine art, galvanoplastic and chemical arts, the transmission of force, mechanical arts, horology, medicine and surgery, astronomy, meteorology and geodesy, agriculture, registering apparatus, domestic uses, lightning conductors, and historical models. The exhibits will also include books. Exhibitors will not be charged for space. Diplomas and medals will be awarded to exhibitors upon the reports of juries organised at the time of the exhibition. It is probable that the Prince of Wales will be president of the congress of electricians and of the exhibition. The exhibition will be opened from half-past eight to six. A general catalogue of the exhibition will be drawn up.

Review.

Diagrams of Magnetism and Electricity. Sheet IV.: The Electric Telegraph. By WILLIAM LEES, M.A., Lecturer on Natural Philosophy, Edinburgh. W. & A. K. Johnston, Edinburgh and London.

No effort has been spared to make this sheet as complete as any of the previous publications of this eminent firm. We think, however, that some of the pieces of apparatus illustrated might have been of more modern pattern. Notwithstanding the assertion in the handbook to the diagrams that "the single needle instrument is extensively used by our railway companies," we doubt very much if there be one of the forms illustrated now in actual use in the United Kingdom. A similar remark applies to the apparatus for the "detection of faults," which has two galvanometers, one in the line and the other in the resistance arm. A perusal of the handbook to the diagrams leaves the impression on the mind that the writer is unacquainted with the practice and present state of telegraphy. We are told, for example, that by means of the automatic system as many as 130 words per minute can be transmitted on *short* circuits. Now it is a well known fact that from 230 to 250 words per minute are daily transmitted between London and Aberdeen.

We are also informed that "after the telegraphing is finished the clockwork is stopped and the strip torn off, and the message written up in ordinary characters," and also that "'duplex working' has been applied with great success to the automatic system, but *two* clerks are necessary at each station, one to attend to the transmitter while the other is engaged at the receiver!" "Duplex" working is defined "as the system by *which two messages are sent simultaneously along the same wire between two stations.*" This is the definition of "diplex working," but not of "duplex working" which is the system by which messages are sent simultaneously in oppposite directions along the same wire.

We have already referred to the apparatus illustrated for the localising of faults. The handbook makes the principle obvious, but a form of Wheatstone's bridge would have been not only more simple, but more in keeping with daily practice.

Notwithstanding these defects and a few others, such as the different meanings given to the word *local*, when used in connection with batteries, the handbook is well adapted for the purpose it is meant to serve, being plainly and simply written, a desideratum in scientific books for school use.

On the artistic and lithographic work we have no blame, but much praise to bestow. The illustrations are excellent, and will doubtless command the success they so well deserve.

Books Received.

Tratado de Telegrafia. Par DON ANTONIO SUAREZ-SAAVEDRA. Tome I.: *Historia Universal de la Telegrafia.*

Les Telegraphes. Par A. L. TERNANT.

La Telescopie Electrique. Par ADRIANO DE PAVIA.

Des Applications du Telephone et du Microphone. Par Dr. M. BOUDET de Paris.

Questions on Magnetism and Electricity. By F. W. LEVANDER.

Correspondence.

THE THERMO-ELECTROPHORE.

To the Editor of THE TELEGRAPHIC JOURNAL.

(TRANSLATION.)

SIR,—On the 19th of March last I made a communication to the French Academy of Sciences on the result of experiments I had made on the transformation of heat into electricity (Comptes-Rendus de l'Academie Français des Sciences, 12th April, 1880). Full details of these results were inserted in *Verkehrs und Industrie Zeitung*, *Bedblatt der Neue Freie Presse*, and in other journals.

I have received since this date from various places a number of letters asking if my thermo-electrophore is of the same nature as a thermopile.

I have the honour to request you to kindly insert the following in your next issue:—

The thermo-electrophore has nothing in common with the thermopile. This apparatus is based upon a new principle discovered by me; the causes of the formation of atmospheric electricity, the origin of the electricity in the Armstrong machine and in others is explained upon this principle. But, what is most important, I have constructed on the basis of this principle an apparatus in which heat is transformed immediately into a current of electricity and with very little loss of energy. The obtaining* of electricity in my thermo-electrophore takes place at the time of the passing of the vapours of certain liquids to the solid state, at the moment when the solorific movement of the vapour becomes transformed, according to my researches, sufficiently completely into electro-molecular movement, or current.

By means of certain arrangements I am even confident of utilising the heat of the air.

If I am able to render my apparatus practicable, according to my calculations, it will be possible to obtain electricity (steam engines and Gramme machines utilising only a tenth part of the heat obtained from the coal consumed) to the extent of two-thirds of the heat expended.

I believe even that by combining the thermo-electrophore with the Gramme machine (which arrangement I call the dynamophore) it will be possible to obtain a motor relatively very light (approximately four times lighter and consuming a proportionately less amount of coal in comparison with the steam engine of equal power).

Accept, Sir, the assurances, &c.,

GREGOIRE BABITSCHEFF.

Vitebsk, *Dec.*, 1880.

VYLE'S RELAY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I have observed in your recent issues two letters respecting the relay made by me and described in the TELEGRAPHIC JOURNAL of the 15th of November, 1880, and I shall be obliged by your allowing me to make the following remarks.

In the description of my relay it is distinctly set down that the principle is not a new one (although at the time the idea first suggested itself to me I was not aware of the arrangement of Professor Hughes, type printer), and as Mr. Brown, of Birmingham, and Mr. Bolton, of Bow, lay claim to having made similar arrangements, I desire to point out that there must always exist a marked distinction between the early and crude efforts exemplifying new ideas and the mature

* The patents have not been yet obtained, or the description of the apparatus would have been published.

and perfected instrument, the result of close attention to the requirements and adaptation of details to produce finished results, and this is the marked distinctive peculiarity of my relay or direct sounder in comparison with those of the gentlemen named. It is a well-known fact that one of the most troublesome, and at times annoying, defects of the present form of relay is the fresh adjustment required, as the line varies in resistance consequent on the changes in the weather or alteration of battery power, especially in duplex working. In the relay designed by me this is almost entirely done away with, and it may be interesting to your readers to know that it is possible to work this relay with a single current key and ten chamber cells through 10,000 ω, which can be increased to 100,000 ω without any alteration in the adjustment.

The maximum speed of this form of relay has not yet been determined, but in actual work on a long line, it has given satisfaction at 130 words per minute; a higher speed would have been tried, but this was the "top" of the transmitter.

The same instrument will act as a direct line sounder, single or double current, and has worked direct double current on a wire 100 miles in length during a week of wet weather, without any complaint, on a circuit fully occupied.

In conclusion, I desire to say that I have no wish to depreciate any other form of apparatus acting upon a similar principle, but simply to claim that the relay in question is superior to any previous attempt in this direction, and that the facts given above are sufficient evidence to substantiate the claim.

I am, Sir, Yours faithfully,

London, *December 27th*, 1880. C. C. VYLE.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AN ordinary general meeting of this Society was held on Wednesday, December 22nd, Mr. W. H. PREECE (President) in the chair. The minutes of the last general meeting having been read and confirmed, the SECRETARY read the annual report of the society.

The report stated that 5 foreign members, 5 members, 46 associates, and 1 student had been added to the society, or a total of 57. Also 17 new members would be added to this number by the 1st of the month. The losses by deaths, resignations, &c., were 29.

A list of the papers which had been read during the year was then noticed, and it was pointed out that several of these papers, especially those on the electric light and the photophone, had been elaborately illustrated by diagrams and apparatus.

In the new numbers of the journals of the society copious extracts from other journals had been made.

The completion of the Ronald's catalogue, it was stated, had caused great satisfaction and had been very favourably noticed by foreign papers and journals; indeed, the demand for the catalogue was so great as to lead to the probability that it would soon be out of print. The completion of the binding of the library and the way in which it had been executed had been warmly approved. The existence of the library had been referred to by Mr. Spottiswoode in his address to the Royal Society.

£50 per annum had been voted for the necessary expenses in connection with the library for the purchase of new books, &c.

Several new works had been added, and it was stated that all the new Electrical Patent Specifications would be laid on the table of the library each week.

The report of the committee on the establishment of a new wire gauge was being considered by the Board of Trade.

In order to allow of more time being available for the arrangement of apparatus for illustrating the lectures it was intended in future that the meetings of the society should be held on Thursday instead of Wednesday, as heretofore.

The application for the incorporation of the society by royal charter, which had been required to be made under the terms of the Ronald's trust, had been made and had been refused; it was hoped, however, that under a recent Act of Parliament the charter might be obtained.

The proposal for changing the title of the society had been considered by the council, and it was proposed that the words "and of electricians" should be added. The members had been written to with reference to the proposals, and out of 353 replies received only 17 dissented.

The financial position of the society was very satisfactory, inasmuch as the loan which had been granted for wiping off the debts of the society had been extinguished in two years instead of seven years, as was originally proposed.

At the conclusion of the report,

Mr. E. BRIGHT and Mr. NEWMAN seconded that the report be adopted. Votes of thanks to the INSTITUTE OF CIVIL ENGINEERS for the use of their lecture hall, to Mr. GRAVES, the honorary secretary of the society, to Mr. BRISTOW, honorary solicitor, were unanimously passed.

The meeting then proceeded to discuss the question of changing the title of the society, in which discussion Mr. A. SIEMENS, Mr. FOSTER, Mr. DONOVAN, Mr. ALMACK, Professor AYRTON, and others took part. The motion being put by the chair, that the title be altered as recommended, was carried.

Motions with reference to certain changes and additions in the composition of the council were also carried.

Mr. F. C. WEBB, having suggested that an index to the series of volumes of the transactions of the society would be valuable, Professor AYRTON, the chairman of the editing committee, stated that an index was being prepared by Mr. Frost, the librarian of the society.

The result of the ballot for the new council for 1881 was then announced as follows:

President—Professor G. C. Foster, F.R.S. *Past Presidents*—Charles William Siemens, F.R.S., D.C.L., Frank Ives Scudamore, C.B., Sir William Thomson, LL.D., F.R.S., Latimer Clark, C.E., C.V. Walker, F.R.S., Professor Abel, C.B., F.R.S., Lieutenant-Colonel J. U. Bateman-Champain, R.E., W. H. Preece, M. Inst. C.E. *Vice-Presidents*—Lieutenant-Colonel C. E. Webber, R.E., Willoughby Smith, Professor W. G. Adams, F.R.S., C. E. Spagnoletti, M. Inst. C.E. *Hon. Treasurer*—Edward Graves. *Hon. Secretary*—Lieutenant-Colonel Frank Bolton. *Council* (Members remaining in office)—W. S. Andrews, William T. Ansell, Sir Charles Bright, H. G. Erichsen, Colonel Glover, R.E., Professor D. E. Hughes, F.R.S., Augustus Stroh, C. F. Varley, F.R.S. New names—Edward B. Bright, H. C. Forde, M. Inst. C.E., Alexander Siemens. *Associate Members of Council* (New Names)—Lieut. P. Cardew, R.E., R. E. Crompton, John Fletcher Moulton, F.R.S.

THE PHYSICAL SOCIETY.—DEC. 11, 1880.

PROF. W. G. ADAMS in the chair.

New members—Mr. W. R. BROWN; Mr. T. WRIGHTSON, C.E.

LIEUT. L. DARWIN read a paper on the "Rate of loss of light from phosphorescent substances." His experiments were made at Chatham, on Balmain's luminous paint, by comparing the intensity of the phosphorescent

light with the light of a sun-burner, the luminous surface being kept cool by placing ice and water near, as a slight increase of temperature in the surface considerably increases the quantity of light given off in a certain space of time. The supply of light was communicated to the paint from a mirror reflecting sunlight. A table and a curve, exhibited to the meeting, showed the rate of loss found by Lieut. Darwin. It is independent of the original intensity of the illumination. According to the curve the light diminishes very nearly in proportion to the square of the intensity of the light. In a report on the use of Balmain's paint in mines, it had been stated that the phosphorescence became brighter a few minutes after exposure in the dark; but the curve showed this to be an error, due probably to the fact that the eye becomes more sensitive to light after being a few minutes in the dark.

Mr. PEARSALL emphasised the advantages of such a light in fiery mines.

Prof. GUTHRIE inquired if the phosphorescent power grew weaker by time?

Lieut. DARWIN instanced a specimen eighty years old to the contrary.

Dr. W. CROOKES stated that in sulphuretted hydrogen and damp air these luminous substances deteriorated. If sealed in a vacuum they would not. Dr. Crookes remarked that in Balmain's patent it was stated that the phosphorescence died out sooner when exposed to a strong light for a short time than to a weak light for a longer time.

Lieut. DARWIN thought this was explained by the slow decrease in the lower part of the curve when the phosphorescence became faint.

Mr. R. J. LECKY mentioned that Evelyn in his diary (1658) describes a phosphorescent powder as "bottling-up" sunlight.

Dr. COFFIN inquired if short exposure to strong light was equivalent to long exposure to feeble light?

Lieut. DARWIN thought not.

Dr. C. R. ALDER-WRIGHT read a full paper on the "Determination of chemical affinity in terms of electro-motive force." He considered first the value of the B.A. unit of resistance which, from different experimenters, might be taken as really 1·005 earth quadrants per second, or not more than ½ per cent. out. Clark's element, when carefully prepared, was practically correct at 1·457 volts, and it kept constant for three or four months after being made, but deteriorated thenceforth some 3 per cent. in about two years. The deterioration was assisted by air, which could not be well excluded by the paraffin cork, as it cracked. If sealed in a Sprengel vacuum the element lasted better. Joule's mechanical equivalent of heat (J) he estimated at 42×10^8, or not over 1 per cent. greater than Joule's water value. The chief result of Dr. Wright's researches was the conclusion that the action of a current in electrolysis is to decompose the electrolyte into "nascent" products, which evolve heat in changing into ordinary products of electrolysis. These nascent products may be the ultimate atoms composing the molecules of the ordinary products, and the heat is given out in these atoms coming together to produce molecules, say of oxygen and hydrogen in the case of water. A number of deductions from this theorem are verified by experiment. One of these is that no gas battery can give an higher E.M.F. than 1·5 volts. Another result, not before published, is that the E.M.F. of a Daniell cell is a function of the current, and is a maximum when the current is indefinitely small. The variation may amount to 10 degrees. Therefore all methods of determining internal resistance by means of two currents of different strength are inaccurate.

Prof. ADAMS inquired if Dr. Wright had seen the letter of Prof. Rowland's assistant, to the effect that Dr. Wright's former estimate of the ohm was on the wrong side of unity?

Dr. WRIGHT.—I have been too busy to see it.

Prof. FOSTER thought that the variation of E.M.F. in a cell with the current was to be expected, and was probably due to the slowness of diffusion.

Dr. WRIGHT thought that diffusion would account for it.

Dr. LODGE said that there was no way of measuring the resistance of a cell except by employing two currents of different strength, and therefore it was necessary to know the law of variation of E.M.F. with current strength.

Dr. WRIGHT stated that he had found two methods of proceeding with currents of the same strength.

With regard to the deduction of Dr. Wright, that no current passes without producing electrolysis, Mr. WALENN inquired if the ordinary law of solution held when there was no evolution of hydrogen, and was answered in the affirmative.

Prof. GUTHRIE cited the experiments of Mr. C. V. Boys and himself on the conductivity of liquids as an instance of a current passing without electrolysis, or if there was decomposition, it was followed by instant recomposition.

Dr. WRIGHT thought there must be electrolysis in Dr. Guthrie's experiments (which were conducted by rotating a glass vessel filled with the liquid between the poles of a magnet, after Arago's experiment), because some two parts of the rotating vessel would be at different potentials, and a current would be set up in the liquid.

The Society then adjourned till after Christmas.

New Patents—1880.

5068. "Improvements relating to telephonic and other systems of electrical communication." J. N. CULBERTSON and J. W. BROWN. Dated December 6.

5083. "Improvements in the manufacture of cables for telegraphic and telephonic purposes and in apparatus employed therein." E. BERTHOUD AND F. BOREL. Dated December 6.

5091. "Improvements in the means for communicating intelligence by electricity, and in telegraphy by induced currents." H. J. HADDAN. (Communicated by S. L. M. Barlow.) (*Complete.*) Dated December 7.

5092. "Magneto-electric speaking telephony." H. J. HADDAN. (Communicated by S. L. Barlow.) Dated December 7. (*Complete.*)

5113. "Telephones." J. B. MORGAN. (Communicated by T. A. Edison.) Dated December 8.

5137. "Improvements in dynamo-electric, magneto-electric, and electro-magnetic machinery and apparatus for the production of light and heat, the transmission of power, and for other useful purposes, and in electric lamps." W. T. HENLEY. Dated December 9.

5141. "Magnetic apparatus, or machinery for separating iron articles or particles from wheat or other grains, either whole or in their various stages of reduction, flour, and other like substances." T. M. CLARK. Dated December 9.

5152. "Electric drills." S. PITT. (Communicated by C. E. BALL.) Dated December 9. (*Complete.*)

5162. "Transmitting and receiving apparatus of printing telegraphs." H. VAN HOEVENBURGH. Dated December 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

1720. "Attachment of telegraph and other conducting wires to insulators." JOHN ROWLANDS EDWARDS. Dated April 27. 2d. In fastening the line wire on to the insulators it is usual to attach it with binding wire. This process is very wasteful of wire; the binding wire wears out sooner than the line wire, and after a time the latter falls. Sometimes, too, the binding wire comes undone, and the ends hanging down spoil the insulation, not merely of their own line wire, but of such other line wires as they touch. The new invention consists in making a wire clip in the shape of a ring welded at the joint of good stiff wire, and of such dimension that when in position, as hereafter described, it will still hold the line wire slightly bent round the insulator with a tight grip. In applying the clip or ring, it is first doubled till the two halves nearly touch; this is done in the manufacture. The line wire is placed between the two loops formed by the doubled ring. The doubled ring or clip is then placed over the top of the insulator, and by a lever forced down into the groove. The strain on the line wire, as well as the rigidity of the ring, prevents any tendency to its becoming loose, and the line is held as in a vice between the insulator, bulging it slightly out and the two loops. (*Provisional only.*)

1738. "Permanent and electro-magnets, &c." SAMUEL RUSSELL. Dated April 28. 6d. Relates to the construction of magnets either permanent or electro, and also to their application to telephonic and

FIG. 1

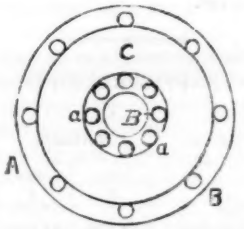
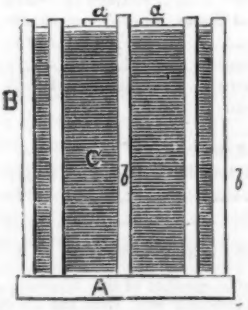


FIG. 2.



telegraphic purposes; and its second part also relates to the construction of magnetic telephones for both transmitting and receiving, and to the connection therewith of transmitting telephones, which operate by varying the resistance to the passage of a battery current. An electric coil, c, of conducting wire is arranged in the annular space between the two rows of poles, as shown in figs. 1 and 2. Fig. 1 is a plain or end view of the magnet with the coil in place, and fig. 2 is a side elevation of the same. When a current circulates through this coil, it will pass outside of the poles, *a*, *a*, and inside of the poles, *b*, *b*, thus acting oppositely upon each in accordance with their opposite polarisation, and it will act to temporarily increase or decrease their magnetism, according as it flows in one direction or the other. In the telephone the armature-diaphragm, instead of being formed of the ordinary sheet-iron plate, which is liable to warp under the influence of several magnetic poles, and thereby to get out of adjustment, is made of wire-gauze formed from fine iron wire, and having its interstices closed or filled by hammering or varnishing.

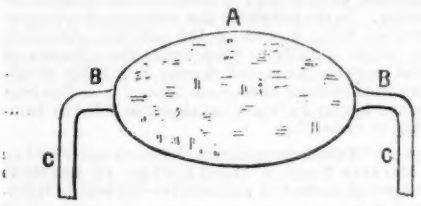
1764. "Telephone apparatus." RICHARD THEILER and MEINRAD THEILER. Dated April 30. 2d. Relates to an improved method of constructing telephonic transmitters, in which the pressure of two contacts against one another is made to vary by the vibrations of a diaphragm or sounding board. (*See* TELEGRAPHIC JOURNAL, September 15, 1880. (*Provisional only.*)

1820. "Electrical signalling apparatus for railways." HERBERT JOHN ALLISON. (A communication from abroad by Hugues Bagilet, of Paris.) Dated May 4. 2d. A telegraphic wire connects the two stations, and at each extremity of the wire is an electric apparatus composed of an electro-magnet, and a soft iron bar or armature, which apparatus is situated between the extremities of the wire connecting the two stations, and of a wire connected with a disc. This disc carries on one side a pivotted bar, which is maintained on the red side of the disc by a spring. A strong spring works the rod carrying the disc, which spring is held by a catch, raised at the proper moment by a very strong electro-magnet. A chain connects the disc with a lever situated perpendicularly between the two rails, where it is maintained by two springs. This lever is fixed to a transmission bar which carries at its extremity an angle piece, which serves during the passage of a train to put the wire of the battery in contact with the wire connecting the two stations. As the train passes it pushes down the lever in the direction in which it is travelling, and at the next station the first named electro-magnet under the influence of the current attracts the soft iron bar or armature, which in turning on a pivot puts the wire from the battery in contact with the wire of the disc. The second named electro-magnet raises the catch, which releases the strong spring and turns the disc towards the station. The disc should be on the same side of the station as the train, so that when the train on this line leaves the station when the signal is against it, the bar pivotting on the disc will move either a lever which causes the whistle of the locomotive to be sounded, and thus warn the driver, or a lever which controls the supply of steam to the cylinders, and thus stop the train. (*Provisional only.*)

1824. "Electric telegraphs." ROBERT CHAPMAN ANDERSON. Dated May 4. 2d. Relates to improvements in electric telegraphs, chiefly applicable to submarine cables, but also applicable for land lines; and the invention consists in the employment, in place of the ordinary cables or wire for conveying the electric current of a fluid conductor contained within a tube of suitable insulating material. (*Provisional only.*)

1840. "Production of electric light." WILLIAM ROBERT LAKE. (A communication from abroad by Thomas L. Clingman, of United States of America.)

Dated May 5. 6d. Relates to the production of electric light. For this purpose a small mass in the form of a sphere or spheroid is used, or an elongated cylinder with convex ends, or a hemispherical mass, as shown by the figure. This mass is composed of the oxide of zerconia, or of a mixture of zerconia and plumbago or other form of carbon, or of zerconia and alumina, or magnesia, or lime, or silica, or mixtures with one or more of these substances. The mass when thus composed of zirconia or plumbago, or other substance,



may also be covered with a thin coating or glazing of zerconia or one of the other substances to protect it from the air. This mass or bead is to be supported on each side by wires or pins of platinum, brass, iron, or other metal connected with copper or other metallic electrodes.

1958. "Telephonic exchange systems." JOHN HENRY JOHNSON. (A communication from abroad by George Lee Anders, of Boston, and Thomas Augustus Watson, of America.) Dated May 12. 1s. 8d. Reates to a telephonic exchange system consisting of the combination of a central station, a series of circuits radiating from the said central station, stations on each circuit, apparatus at each station controlled and operated from the central station, which apparatus, when communication is desired at the said station, will give an audible signal at that station only; switching devices at each station for securing secrecy, means at each station for calling the central station without signalling any other station on the same circuit, signalling apparatus at the central station for sending currents of the proper number and character to cause an audible signal at any desired station on the same circuit and a signal at the other stations that the line is in use; and a switch board at the central station, whereby any circuit can be connected with the signalling apparatus at the central station, and any two circuits can be connected together.

1960. "Insulators for telegraph wires, &c." GEORGE WELLS and ARTHUR GILBERT. Dated May 13. 2d. The invention consists of an insulator of earthenware, stoneware, porcelain, or other suitable non-conducting material of bell or mushroom shape, surmounted by a head either square or flat-sided, or so shaped as to receive nuts and bolt-heads conveniently. Through the head of the insulator two (or, if preferred, one) or more bolts are passed by the side of, but clear of contact with, the bolt which passes up the centre of the insulator for securing it to the pole or arm of the pole. These bolts have a small groove cut in the inner side of their heads to grip the wire, and a corresponding groove or bed is made in the earthenware or in a continuous metal washer under the bolt-heads. The wire may be attached to the insulator either at the side by placing the gripping bolts horizontally, or on the top by placing them vertically, or at any angle with the nuts below, aud in either case the wire when strained has only to be placed in position and the nuts screwed up tight. (*Provisional only.*)

The following are the final quotations of telegraphs for the 29th ult.:—Anglo-American Limited, 59¾-60¼; Ditto, Preferred, 89-90; Ditto, Deferred, 30¾-31¼; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9⅞-10⅛; Cuba, Limited, 8¼-9; Cuba, Limited, 10 per cent. Preference, 16¼-16⅝; Direct Spanish, Limited, 2⅞-3⅛; Direct Spanish, 10 per cent. Preference, 12¼-12¾; Direct United States Cable, Limited, 1877, 10⅜-11; Scrip of Debentures, 101-103; Eastern, Limited, 9⅛-9⅜; Eastern 6 per cent. Preference, 12⅝-13; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 101-104; Eastern, 5 per cent., repayable Aug., 1899, 104-107; Eastern Extension, Australasian and China, Limited, 10-10¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 110-113; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 106-108; Ditto, registered, repayable 1900, 106-108; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent., Mortgage Debentures redeemable 1900, 103-105; Ditto, ditto, to bearer, 103-105; German Union Telegraph and Trust, 10¼-10⅝; Globe Telegraph and Trust, Limited, 6⅛-6⅜; Globe, 6 per cent. Preference, 12-12½; Great Northern, 10⅞-11⅛; Indo-European, Limited, 25-26; London Platino-Brazilian, Limited, 5⅛-6⅛; Mediterranean Extension, Limited, 2⅞-3⅛; Mediterranean Extension, 8 per cent. Preference, 10⅞-11¼; Reuter's Limited, 10¾-11¼; Submarine, 260-265; Submarine Scrip, 2⅛-2⅜; West Coast of America, Limited, 2⅝-3⅜; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 6⅞-7¼; Ditto, ditto, Second Preference, 6-6⅛; Western and Brazilian, Limited, 8⅞-9⅛; Ditto, 6 per cent. Debentures "A," 106-110; Ditto, ditto, ditto, "B," 98-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 35-35½; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 17⅞-18¼; Ditto, 6 per cent. Debenture, 106-108.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	NOVEMBER.		INCREASE OR DECREASE.
	1880. £	1879. £	£
Anglo-American.....	*	67,380	...
Brazilian Submarine ...	†14,574	14,540	Inc. 34
Cuba Submarine	1,900	3,110	Dec. 1,210
Direct Spanish	1,465	1,334	Inc. 131
Direct United States ...	*	22,460	...
Eastern	47,669	46,147	Inc. 1,522
Eastern Extension	29,724	26,379	Inc. 3,345
Great Northern	20,800	16,653	Inc. 4,147
Indo-European	...	...	...
Submarine	*	...	...
West Coast America ...	...	...	...
Western and Brazilian	‡9,739	12,337	...
West India	2,393	4,772	Dec. 2,379

* Publication temporarily suspended. † Four weeks.

‡ The traffic receipts of the Western and Brazilian Telegraph Company will, from the 1st of October, be published exclusive of the fifth of the gross receipts payable to the London Platino and Brazilian Telegraph Company, Limited, which fifth has hitherto been included in the amounts published.